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Investigation of Municipal Lighting for Rockland, Mass.

THE town of Rockland, Mass., though having a population of only about 7,000, is thoroughly alive to the question of obtaining better lighting conditions at a lower cost. In compliance with a vote taken by the annual town meeting, held in 1911, William Plattner, a consulting engineer of North Attleboro, Mass., was retained to investigate the electric lighting service and to make recommendations for the betterment. The results of Mr. Plattner's investigations have recently been presented in a report to the voters of the town, and form an interesting commentary on the lighting conditions in similar towns in Massachusetts.

Electric current for Rockland has been and is at present furnished by the Electric Light & Power Co., of Abington and Rockland. The plant is located outside of the town of Rockland, so that the equipment which is appraised in the report and inventory is only that which is utilized in the distribution of the current. The current sold to the town as measured at the meters of the consumers is shown to be as follows:

	K.W. Hours.
Commercial lighting	155,582
Power	400,383
Street lighting	49,338
Total	605,303

For this current the following rates were charged:

Eighteen cents per kilowatt hour with a minimum charge of $12.00 per year and a 10 per cent. discount for bills paid before the 15th. Sixteen cents per kilowatt hour for the first 50 hours' use of the connected load per month, and 7 cents for all additional, with the same discount provision. The power rates varied from 9 cents to 3.4 cents, dependent on the amount of current used between the maximums of 175 and 3,500 k.w. hours. Installations of over 10 h. p. paid a service charge of $2.00 for the first kilowatt of maximum motor rating and $1.25 for each additional kilowatt plus a current charge of 3½ cents per kilowatt hour. Installations of 50 h. p. and over paid 3 cents per kilowatt, with discounts according to the capacity. A flat rate of $16.00 per lamp was made for each of the 310 40-watt street lamps.

In the appraisal made by Mr. Plattner, allowance was made only for depreciation due to wear and tear due to use and to natural decay, there being no material which was obsolete; and the market value of the materials at the time of inventory was assigned in each case. The estimated cost of the plant under these conditions was:

Pole lines, services, etc., together with labor of placing	$29,417.75
Street lamp fixtures and supplies, with labor	1,555.60
Transformers, meters, etc., in place	12,908.25
Motors with wiring, materials, etc., in place	6,651.00
Commercial incandescent lamps.	1,200.00
Fan motors, arc lamps, holophane shades	615.00
Total	$52,347.60

As will be noted, there is no allowance for real estate such as would be necessary should current be purchased and distributed from a central distribution station by the city.

By reason of the dissatisfaction with the rates and service under the existing plant, there were two plans investigated by means of which the town could obtain its light under different conditions. The first of these plans was the construction of a municipal lighting plant, which might be operated by the city to give service both for street lighting and for private lighting and power purposes. The second plan involved merely the erection of a central distribution station from which current purchased from an outside corporation might be transformed and distributed for the purposes above noted.

In submitting an estimate of the cost of a plant for the town, Mr. Plattner assumed a day load of 250 k.w., 10 hours, with a duplication of machinery to take care of the "peak load." An additional

unit of 100 k.w. capacity was also recommended to take care of the lighting from 1 a. m. until 6 a. m. This arrangement provides for no reserve unit for use in case of a breakdown. The estimated cost of the plant complete with two 300 k.w. units and one 100 k.w. unit, land, buildings, power house appurtenances and distribution lines was stated by Mr. Plattner at $123,073.

The plant as estimated was figured on the basis of steam turbine engines operating condensing. No consideration was given to gas or oil engines or to reciprocating engines. It was held that a larger initial investment would be required for the oil or gas engines and that as the load factor was very good in Rockland, no economy could be obtained by their use.

The cost of equipment required in case it should be decided to purchase current from an outside source, included only pole lines, transformers, meters, land and a transformer house. The amount stated by Mr. Plattner was $70,073, including $3,000 for engineering and working capital, which amount was also allowed for management in the plant installation.

In drawing comparisons between the two plans outlined and the existing conditions in Rockland, careful consideration was given to the matters of depreciation and repair items. In the former case, a depreciation of 5 per cent. was charged on both the completed plant and on the distribution station. The statutes of Massachusetts require only a 3 per cent. allowance for depreciation, but provide that the Board of Gas and Electric Light Commissioners may have the final decision in event that a larger or smaller amount is recommended. On the other hand, no provision is made for a fixed charge against the town for street lighting service, as the basis of computation for the plant is taken as the total of the kilowatt hours generated under the present conditions; the meter output having been taken and allowances made for all transmission and other losses. The gross income of the present electric company was $35,040 for last year. The two tables following give the operating expenses of the two propositions, as presented by Mr. Plattner:

OPERATING EXPENSE OF THE PROPOSED MUNICIPAL POWER PLANT.

Four per cent. interest on total cost, as estimated	$ 4,922.92
Five per cent. depreciation on plant and distributing lines	5,653.66
Coal, based on 721,000 k.w. hours, and station losses	6,500.00
Station wages	5,000.00
Insurance—Fire, liability and boiler	300.00
Supplies and repairs	1,500.00
Maintenance on distributing system	3,000.00
Management	3,000.00
Total operating expense	$29,876.58
Notes paid annually	$ 2,000.00
Amount paid into sinking fund.	2,000.00
Total expense	$33,876.58
Present income from plant on basis of above noted output	$35,040.00
Operating expense of proposed plant	33,876.58
Unexpended balance	$ 1,163.42

OPERATING EXPENSE OF PROPOSED DISTRIBUTION PLANT FOR PURCHASED CURRENT.

Four per cent. interest in distribution system	$ 2,802.92
Five per cent. depreciation	3,178.66
721,000 k.w. hours, at 2½ cents per kilowatt	18,025.00
Maintenance and repairs	3,000.00
Repair and care of street lamps.	1,200.00
Management	3,000.00
Total	$31,206.58
Present income for light and power in Rockland	$35,040.00
Operating expenses of distributing plant	31,206.58
Unexpended balance	$ 3,833.92
Sinking fund	1,500.00
Amount saved on purchasing current as computed	$ 2,333.92

In making the above comparisons, Mr. Plattner states that there are a number of towns in the state which purchase current at the rate of from $0.023 to $0.04, so that he feels justified in setting the cost of current thus purchased at 2½ cents.

There are several items in Mr. Plattner's comparison, as drawn, with which there might be a disagreement. There is no explanation of the item "Notes Paid Annually" in the statement regarding the complete plant, and which does not appear in the comparison of the distributing plant. The sinking funds in both cases might be larger, though the proportion observed is such that it is evident that the same basis of computation in each case was used. Ample allowance for repairs and depreciation, according to present practice seems to have been made.

In the latter portion of his report, Mr. Plattner gives some interesting tables with relation to the electric lighting situation in different towns in Massachusetts. From these tables, the following table is given to show the rates charged in various Massachusetts towns upon the same class of lighting unit as is used in Rockland:

MUNICIPALLY-OWNED PLANTS.

Town.	Population.	No. Lamps.	Capacity In Watts.	Hours Per Day.	Days Per Month.	Cost Per Lamp.
Reading	5,818	19	50	10.4	30.4	$ 4.53
Danvers	9,407	14	40	7.0	27.8	.40
Danvers	9,407	75	50	7.0	27.8	.50
Concord	6,421	863	50	9.3	30.4	4.98
North Attleboro.	9,562	206	40	5.8	27.9	4.50
North Attleboro.	9,562	506	50	5.8	27.9	5.62

MUNICIPALLY-OWNED DISTRIBUTION STATION FOR PURCHASED CURRENT.

Town.	Population.	No. Lamps.	Capacity In Watts.	Hours Per Day.	Days Per Month.	Cost Per Lamp.
Norwood	8,014	389	40	6.3	25.9	$ 1.43
Wellesley	5,413	72	40	8.6	29.3	3.48
Wellesley	5,413	221	50	8.6	29.3	4.35

PRIVATELY-OWNED PLANTS.

Town.	Population.	No. Lamps.	Capacity In Watts.	Hours Per Day.	Days Per Month.	Cost Per Lamp.
Amherst	5,112	165	50	5.2	27.5	$16.00
Palmer	8,610	175	40	5.8	26	15.00
Warren	4,188	150	40	5.8	26	15.00
Leominster	17,580	97	50	5.7	29.7	16.00
Everett	33,484	646	50	5.7	27.5	15.00
Northborough		111	50	6.7	27.5	16.00
Whitinsville		221	40	5.5	27.6	14.50
Dudley	4,267	125	50	5.4	30.4	13.30
ROCKLAND	6,928	310	40	5.4	28	16.00

TABLE OF QUANTITY AND COST OF STREET ILLUMINATION IN EIGHTEEN MASSACHUSETTS TOWNS.

Town.	Population.	Total C. P. of Street Lamps.	Total Cost Exclusive of Taxes.	C. P. Per Capita.	Cost Per Capita Exclusive of Taxes.
Belmont	5,542	35,920	$ 5,744.75	6.4	$1.03
Braintree	8,066	128,400	6,370.75	15.9	.59
Concord	6,421	42,520	4,787.37	6.6	.74
Danvers	9,407	174,398	1,401.52	18.5	.15
Hingham	4,965	26,760	3,745.27	5.5	.75
Hudson	6,743	33,020	1,021.04	4.9	.15
Hull	2,103	16,864	11,047.31	8.0	5.25
Ipswich	5,777	12,736	4,083.03	2.2	.76
Mansfield	5,183	18,232	6,509.57	3.5	1.25
Marblehead	7,338	185,345	10,396.20	25.2	1.41
Middleboro	8,214	37,267	5,218.78	4.5	.64
North Attleboro.	9,562	26,792	4,493.34	2.8	.46
Norwood	8,014	25,828	1,518.24	3.2	.18
Peabody	15,721	151,664	18,078.55	9.6	1.14
Reading	5,818	167,620	6,447.45	28.8	1.10
Wakefield	11,404	74,080	11,729.97	6.4	1.02
Wellesley	5,413	31.409	5,074.54	5.8	.93
ROCKLAND	6,928	12,480	6,300.00	1.9	.88
Average of first 17		69,938		9.2	$1.42

Of the towns above noted only a very few use the tungsten 40-watt or 50-watt lamp exclusively, and in every case the municipally-owned plants use higher power tungsten and arc lamps. In 17 towns having their own lighting plants

Of the towns in first table above only a very few use the tungsten 40-watt or 50-watt lamp exclusively, and in every case the municipally-owned plants use higher total candlepower of street illumination in these 17 towns was shown to be 69,938,

while in Rockland it is only 12,480. In conclusion, a table is given from which the data regarding candlepower of illumination, cost, and unit cost in the last table are taken. All of the first 17 towns given have municipally-owned plants, Rockland being the only exception in the table.

As may be noted from the above table, if Rockland received the same candlepower per capita of light upon the streets, and the rate remained the same, the cost per capita, exclusive of taxes, would be $4.04 instead of $0.88, as at the present time.

Some Considerations in the Choice of a Pavement.*

By Prof. Leonard S. Smith, University of Wisconsin, Madison, Wis.

WHAT is the best pavement? is a question which citizens, city officials and even some engineers are not infrequently guilty of asking, forgetful of the plain fact that such a question admits of no ready or simple answer. As well might it be asked what is the best bridge or the best house to build. It is a most hopeful sign that the past year has seen many papers read at engineering society meetings discussing this question of considerations affecting the choice of a pavement.

It cannot be too emphatically stated that in each case the best structure for a pavement depends upon the particular service required of it and also, too, upon the widely varying local conditions. These modifying factors naturally divide themselves into two general classes. The first of these govern the conditions to which the pavement will be subjected. Chief among these factors are the quality, nature and even the direction of the traffic, the character of the district served by the pavement, the grade of the street and the presence of car tracks.

On the other hand, the second class of factors which may determine the selection have reference to the character of the pavement itself, such as durability, smoothness, noiselessness, slipperiness, cost, etc.

The best pavement for some particular street, then, would be the one which would give the greatest and most needed service, using the word service in a broad way. The limits of this paper will not allow of a full discussion of this question, but my point can be most clearly explained by giving a few applications of the principle. For example, if the street had a steep grade, all such considerations as smoothness, noiselessness, cost, etc., must needs give way to the single governing quality of non-slipperiness. Again, if the street in question were on a moderate grade in a high-class residence district or in the office-building district of a large city, the factors of smoothness and noiselessness might properly determine the final selection. Such a selection, while involving a very expensive pavement, has repeatedly been shown to fully justify itself by the added value and earning capacity of the property. As a third example, considering the choice of a pavement in a wholesale district, subject to concentrated heavy traffic, the qualities of durability and non-slipperiness would here naturally receive the greatest consideration.

The above statements are so obviously based on common sense that it may seem to some useless to take up valuable time in their presentation. Repeated inspection of the pavements in a score of our largest cities has shown the writer that the choice of pavements has too frequently been left to chance or prejudice. Our growing vision of municipal efficiency discerns a much-needed reform in the choice of our pavements, a reform certain of realization.

But while there is great economic need that the best fitted pavement for each particular street should be thoughtfully and carefully chosen, it is at least of equal importance that all such paving improvements should proceed in accordance with some well-considered plan—some comprehensive system for future improvement of the entire city, ward or region. For example, pavement improvements should be so planned as to provide several parallel routes for through traffic. If this be not done, the single route becomes congested and the pavement is prematurely worn out. Again, pavements should be continuous, both for the convenience of traffic and for ease of maintenance.

In the case of country highways, it is necessary to construct disconnected stretches of pavement, but even here it is of prime importance that such construction should proceed in accordance with a systematic plan, so that disconnected stretches may eventually become a part

*A paper before the Engineering Society of Wisconsin.

of a complete system. For example, in our own State it would be easy to select a few trunk roads leading from the metropolis of the State to the adjoining cities, and still others connecting the largest city or county seat of each county, as being certain to attract the heaviest traffic. Portions of such trunk roads should be improved with reference to sustaining heavy traffic and also with a view of becoming a part of an intra-state system.

Unhappily, the city paving program is too often determined by the ward politician or the opposition or favor of short-sighted real estate owners. A few cities which have tried this plan of adopting a paving program extending over ten years will soon occupy an enviable position. Our cities cannot do better in this respect than to follow the example of the most successful railroad companies.

While future traffic conditions may render necessary here and there a change in the detail plan, the city is certain to gain largely in the end because of having a carefully prepared plan for all street improvements, including water, sewer and gas as well as pavements.

The charter of many American cities provides that the abutting property owners shall pay for the first pavement, while the city must pay for all repairs and renewals. As might be foreseen, this has resulted in the selection and construction of many cheap and inferior pavements, where much more permanent construction would have been justified. But this abuse has not stopped here. Long time bonds have been commonly issued to secure the payment of such temporary pavements, in many cases falling due twenty-five years or more after such pavement has utterly worn out.

Such a system of financing pavements cannot be characterized as anything short of dishonest. It simply transfers to the backs of our children the burdens we of right should bear ourselves. For the future will doubtless have sufficient burdens and problems of its own without being required to shoulder in addition those of today.

Already legislatures are considering corrective legislation. The writer knows of at least one eastern legislature which in 1910 passed a law prohibiting a city from paying for short-life pavements out of the proceeds of any bond sales. This principle of "pay as you go" deserves a wide adoption.

It is worthy of restatement that cheapness does not necessarily mean a cheap price of the pavement when laid; indeed, such a pavement may likely prove the most expensive in the end. The other governing elements which determine the actual cost of a pavement are the annual cost of repairs and the term of life of the pavement. Permanent pavements may properly be paid for out of the proceeds of bond issues payable during the life of the pavement. In such cases the public will eventually have to pay for the following items: Interest on the bonds, cost of repairs and annual sums for a sinking fund, which by the time the pavement is worn out will pay off the bonds. Such a plan may be shown by the following formula:

$$S + CI + \frac{R}{L} = \text{annual cost},$$

where S = the yearly amount put in the sinking fund
C = first cost of the pavement
I = the rate of interest
L = the life of the pavement in years
R = the total cost of repairs.

Obviously, the cheapest pavement is the one involving the least annual cost. If, for example, macadam pavement be chosen for a street having traffic, the last term $\frac{R}{L}$ would be so large as to make such a pavement the most expensive type that could be chosen. This fact is an added illustration of the importance of a wise selection of a pavement for the traffic conditions.

New York state for several years has been making the collosal mistake of issuing many millions of long-time bonds in payment of some form of macadam even on heavy traffic trunk highways, where they very frequently have failed after a comparatively short term of service. Such is the judgment of well qualified engineers who have had charge of the construction and maintenance of such roads. The seriousness of this situation will not be fully realized until after the officials responsible for this error have passed to their final reward. Other states nearer home have made similar mistakes.

The construction of some form of the macadam road fulfills at a minimum cost all reasonable demands on streets or country highways carrying a moderate traffic, especially if such roads have the added protection of continuous maintenance. This class includes over half of our country roads.

But if such improved highways happen to connect two or more large cities, the unusually heavy traffic which such a road at once attracts results in certain and speedy failure. The advent of automobile and other forms of motor traffic, while it has lengthened the life of hard city pavements, has been the chief cause of the destruction of macadam roads. The seriousness of this problem of the choice of proper road material is realized when we reflect that the demands made by this new form of motor traffic are cer-

tain to greatly increase in the near future. Highway engineers of every land are looking for an adequate remedy, but so far with only partial success. While constructional methods in nearly all other lines of engineering have been satisfactorily perfected and standardized, we find present highway construction on main trunk roads grossly inadequate for even the traffic of today, thereby causing needlessly large charges for maintenance.

It has seemed to the writer that real progress would be made by breaking away entirely from macadam construction on heavy traffic main highways. The improved and more permanent construction best suited to replace the macadam on such roads will here again be largely a local question. Ohio, Indiana and Pennsylvania have taken the first steps toward satisfying the demand for a more permanent construction by building many hundreds of miles of brick pavements laid on a concrete base with a cement grout filler, all supplemented usually by wings of dirt, gravel or macadam. The expense of such a pavement, about $1,000 per foot of width per mile, does not exceed the average price paid by New York state for its wider but short-life macadam roads, while the brick roads, if properly constructed, promise to be in good condition twenty-five years hence.

Wayne county, Michigan, has constructed a good many miles of main highways, leading out of Detroit, of rich concrete, seven inches thick, at prices which also compete with eastern macadam, while giving promise of outlasting the latter by many years. Where the proportion of automobile traffic is not too great, a large amount of traffic has generally been economically provided for by some form of the bitulithic construction. It may be that Wisconsin, with her widely distributed rich deposits of good gravel and other road materials can wisely follow one or all of these forms of permanent construction. Few states are more favorably situated for road building than Wisconsin. We are fortunate also in being able to profit by the experiments of our older sister states. These have shown us that there is no one best pavement and no one best way of constructing it under all circumstances.

We now recognize that the selection of road material and the method of incorporating it into a road is in large part a local question; in fact, that highway construction in city and country obeys the same rules of procedure as do all other forms of good engineering.

Practical Road Building.*

By John N. Edy, Assistant City Engineer, Billings, Mont.

MACADAM ROADS.

THE distinguishing feature of macadam road construction is the use of angular pieces of crushed stone, which, when rolled with a binder, are packed and wedged into a dense mass. Obviously, the value of the improvement depends largely upon the quality of the stone selected. While the foundation course may be built of inferior material, the wearing surface or top course must be of the best stone obtainable. The characteristics that determine the value of road metal are hardness, toughness and cementing quality. It is difficult to find these three important characteristics in any one stone. For instance, limestone is admirable for moderate traffic, possessing the quality of binding, but being not very hard. Sand stone is too soft for road uses, except in the foundation course. Granite is harder than, but does not bind so readily as, limestone. It is often advisable to use the hard, tough stone in the wearing course, and to use for a binder the screenings of some stone which has cementing value.

It may be that crushed gravel is the best available material. In communities just undertaking road improvement, it is usually a case of using local stone, even though the life of the road is shortened. When there is a great difference in the cost of local and imported stone, it will be cheaper to use the local material and resurface the road when necessary. The reader is reminded that the United States Office of Public Roads (in the Department of Agriculture), undertakes to make free tests and reports on all road material sent it. As the supervisor will hardly be an expert judge of these matters, he is advised to take advantage of this Government laboratory.

The method of placing crushed stone for a waterbound macadam is practically the same as outlined for a gravel road, except that the roller should weigh not less than 10 tons. The sub-grade must be carefully prepared, and the material placed in courses as noted. All dust is screened out and the binder applied in the proper amount to both courses. The top

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course should follow closely the completion of the foundation, say 100 or 200 feet intervening. The sizes of stone usually adopted are, for the foundation, ¾ to 2½ or 3 inches; for the top course, ¾ to 1½ inches; using all materials between, but none above or below the limits given. The surface slopes and the blind drains are built as explained under gravel roads. It is not good practice to use clay with a macadam binder. Continued rolling and sprinkling, together with the addition of a little sand or fine gravel, will cause the materials to bond. The binder used must contain some dust or fine powder, and water must be added to cause this binder to cement. It is not necessary that expensive screenings be spread over the completed macadam surface; but if some cushion coat is desired, sand may be used, and will usually be cheaper.

It will be found that the shoulders of a gravel or macadam road built on a clay sub-grade will be more easily maintained if they are coated with a surface of sand clay mixture. They will also better withstand the effects of travel that may come on them due to the passage of vehicles. And, as has been noted, this surface is most desirable when a single track improvement is used. The principal points to be observed are these:

1. The use of the most suitable stone, which must be crushed into angular fragments of proper sizes.
2. Thorough preparation of sub-grade, and the construction of shoulders to hold the materials in place.
3. The placing of the screened stone in courses, each to be bound and rolled with a heavy roller until firm.
4. The use of just enough binder, added separately, to fill the voids in each course.

Obviously the drainage must be cared for before construction begins.

It will be seen that the selection of the stone, especially for the foundation course, is mainly a question of utilizing the local product. Good macadam roads have been built on a gravel base. The success of highway improvement depends largely upon the length of road that is built for the money at hand. It is never economy, however, to work along wrong lines in an effort to satisfy all the taxpayers. There will always be a certain amount of dissatisfaction, no matter how valuable or how economical the improvement. The road builder must be sure that his methods are right and his materials the best he can get, and he should then spend enough money on the making of the road to insure the best results.

MAINTENANCE.

No effort should be made to maintain the surface at its initial thickness, the only requirement being that it be kept smooth. This is done by placing good material in ruts and other places of abnormal wear, always loosening the old surface before putting on the new stone, and never filling depressions with screenings alone. As previously stated, raveling may be prevented to a certain extent by covering with a thin layer of sand. Inasmuch as wind and continued dry weather cause damage to the road, every effort should be made to conserve the moisture and avoid rapid evaporation. This may be done by planting shade trees along the roadside; it is rare that a community can afford to sprinkle their roads. In hot, dry climates, therefore, it is questionable if uncrushed gravel roads should ever be built without the use of some asphaltic binder in the surface course. And while macadam may give better service under these conditions, no great expense should be incurred without considering the use of asphalt binder.

BITUMINOUS MATERIALS.

A new road destroyer has been developed in recent years in the shape of automobiles driven at high speed. But it is not the automobile in itself that harms the road. It has been demonstrated that motor traffic is not injurious to macadam roads, when the speed is kept within a limit of 15 miles per hour. And because these modern machines are being adopted by so many people, farmers, as well as others, for business and pleasure, it is useless to rave over the damage done by the automobile and go on treating our roads in the old way. The automobile and motor truck have come to stay. They have come to be used as a cheap means for every kind of transportation; and while any community may do its best to regulate the speed of this vehicle, the sensible thing to do is to meet the issue squarely by adopting some sort of surface treatment for those roads of greatest automobile traffic. Furthermore, as intimated above, this surface treatment is of real value to those roads that must exist under unfavorable climatic conditions, whether the motor traffic be excessive or not.

While it is highly improbable that the supervisor will be called upon to use asphaltic oil in road improvement without the advice of an expert on the subject, the following brief suggestions are nevertheless offered. In the first place, not all oils are suitable for road uses. While it is true that practically any oil sprinkled on the road will give temporary relief from dust, only those that run high in asphalt are of permanent value to the road. The asphalt is usually mixed with, or contained in, some lighter oil, which, upon application, evaporates and leaves the heavy binder to cement the surface particles together, forming an impervious crust over the road. Natural oils with an asphaltic base are used for this pur-

pose, as are also tars. The economy of this treatment lies in the reduced cost of maintenance, and the better service which the road gives. There are two distinct applications of this principle, namely:

1. Constructing a new road with a bituminous binder; and
2. Applying the binder to the existing road.

It must be remembered that this type of road improvement is still in an experimental stage, insofar as any standard plans are concerned. The larger cities, those states having modern highway departments, and the United States Office of Public Roads, are making extensive investigations along these lines. Authorities agree that the principle is correct, that will prove most economical. Because of this, and while investigating this phase of the subject, the Commission considers it advisable to use in general only the commonly used and inexpensive surface treatment of bituminous binder, using about one-half gallon to the square yard, and covering with stone screenings, fine gravel or coarse sand."

"Bituminous surfaces should have a crown somewhat less than the ordinary macadam road, probably ⅜ inch per foot. The binder may be spread from a spraying machine, which heats and spreads the material over the road under pressure. In one instance, lighter oil was spread from a sort of trough made of two boards with an opening at the bottom, which was

MACADAM ROAD IN CASS COUNTY, MO.

but the exact method of carrying it into effect is still an open question. It has even been suggested that macadam roads be built acocrding to ordinary practice, and a thin coat of bituminous bound stone or gravel applied to the surface. The following notes regarding the treatment of old roads are taken from the 1909 Report of the Massachusetts Highway Commission:

"The doubt that exists is not as to the use of some bituminous binder, but which binder to use and the method of applying it. In many instances the bitumen must be used in the first construction of the road, but experience alone will determine the exact nature of the binder mounted on wheels, and which received the oil from a barrel. Oil has also been applied from an ordinary half-moon watering cart. When the heavy asphaltic oil was used, it was found necessary to heat it before applying. In all cases before applying the bitumen, the surface of the road should be thoroughly cleaned, all depressions filled, the road brought to a true crown and grade, and compacted. The oil or tar should then be spread as evenly as possible over the surface, brooming it in where necessary to secure a uniform coating, and covering with sharp sand, fine gravel or stone screenings, from which the dust has been removed, to a depth of ½ or ¾ inch. The

road may then be thrown open to traffic. During the first few weeks after the road has been treated, covering material should be added whenever the oil or tar appears upon the surface. * * * * *"

It is customary to have the road in a perfectly dry condition, using from one-third to one-half gallon of oil per square yard of surface. This, of course, refers to the treatment of existing roads. The road must be carefully shaped, depressions being filled with stone ranging in size from ½ to 1½ inches. The oil should be permitted to penetrate into the road for 3 to 5 hours, depending on the temperature and condition of the road. The use of the asphaltic oil and fine gravel covering preserves the road, and does away with the dust. It is essential, however, that the covering be free from dust.

The following is taken from Bulletin No. 10, Missouri State Highway Department, regarding the use of macadam asphalt binder in the construction of new roads; binder 90 per cent. asphaltum:

"1. Specifications for macadam roads, as generally constructed, shall be followed in all particulars, except as follows: After the laying of the top course of stone, sand or screenings shall be spread over the surface to fill approximately 50 per cent. of the voids. The rolling of the top course and the spreading of the sand or screenings shall be continued at the same time, and until the sand or screenings have been settled to the bottom. In no case must the sand or screenings be applied in such quantities as to form a cushion upon the surface of the road.

"2. After the road has been prepared as above described, there shall be applied the asphalt binder, by means of a sprinkler of suitable design, such that the quantity of binder can be regulated and the width of application varied. The binder shall be applied at a temperature of from 150 to 175 degrees Fahrenheit. The quantity of binder to be used shall, in general, be sufficient to completely fill the voids in the stone, and to form a coating upon the surface. This quantity will vary from 1¼ gallons to 1½ gallons per square yard of surface. The binder shall be further incorporated into the voids with brooms, or by other means.

"3. After the application of the asphalt binder, screenings or sharp sand shall be spread so as to cover the binder. The surface shall then be thoroughly rolled until the remaining voids in the stone are filled with the bituminous mixture and a firm, even surface is formed. Screenings or sharp sand shall then be spread and broomed so as to absorb any of the binder that flushes to the surface and the same rolled; this process to be continued until no more asphaltum binder is brought to the surface.

"4. During the application of the asphalt binder, and until the road is finished, provision should be made to keep all travel off the road. The binder must be applied only in dry, warm weather, and no moisture should be present in the mineral aggregate when it is used.

"5. Provisions should be made to have a sufficient length of road ready to receive the asphalt binder, so that no delay need occur in applying the binder in a heated condition.

"Macadam asphalt binder can be shipped in tank cars or barrels. Tank cars are equipped with heater coils and binder can be heated to required temperature by means of a portable boiler of from 10 to 20 horsepower, when steam cannot be supplied from a stationary plant."

The above notes give some idea of the uses of asphaltic binders. As has been stated, tar is being used extensively for the same purpose. The road official will do well to investigate this method of preserving and maintaining macadam roads, being careful as to the binder he may purchase. In fact, the supervisor or commissioner should in no case undertake the construction of asphaltic macadam, or the application of oil to an existing road, without seeking the advice of some nearby city or state official experienced in the work, and familiar with the local conditions.

OIL AND EARTH ROADS.

Asphaltic oil has been used in the improvement of earth and sand roads, with very satisfactory results. The method is substantially as follows: The road is first drained and crowned; the surface is then loosened to a depth of about 6 inches, by plowing. The material is pulverized with a harrow. Two or three applications of asphaltic oil are given the road, after each of which the oil and earth are mixed by thorough plowing and harrowing. In some instances the mass is sprinkled with water during the mixing process. The road is finally shaped with a grader, and rolled until firm and smooth. The total amount of oil used for this construction will vary from one to three gallons per square yard of surface covered, depending upon the thoroughness of the work and the degree of perfection desired. For the given depth of 6 inches, however, probably not less than two gallons per square yard should be used, in two applications of ¾ gallon each, and one application of ½ gallon. For a depth of less than that assumed less oil may be used.

Sand roads may be readily improved in the manner outlined above. The oil earth road may be surfaced with 2 inches of fine gravel, bound with the oil, and a permanent and very desirable roadway result.

Use of Bituminous Material on Highways in 1911.*

By Prof, Arthur H. Blanchard. Columbia University, New York City,

AS CONSIDERABLE confusion arises because of misunderstanding of the various expressions and terms used in describing materials and methods of construction, certain definitions are given in order that the content of the descriptions as set forth below may be manifest to all. The nomenclature used in this paper covering bituminous materials and their use in the construction of roads and pavements follows:

Asphalts are solid or semi-solid native bitumens, solid or semi-solid bitumens obtained by refining petroleum, or solid or semi-solid compounds which are combinations of the bitumens mentioned with petroleums, or derivatives thereof, consisting of a mixture of hydro-carbons of complex structure, largely cyclic and bridge compounds, melting upon the application of heat.

Asphaltic petroleums are petroleums which yield asphalts upon reduction.

Asphalt cement consists of an asphalt, pure or mixed with foreign matter, which may or may not be fluxed with petroleum residuums.

Bitumens are mixtures of native or pyrogenous hydro-carbons and their non-metallic derivatives, which may be gases, liquids, viscous liquids or solids, and which are soluble in carbon disulphide. This definition was proposed by Committee D-4 of the American Society for Testing Materials.

Bituminous macadam pavements are those having a wearing surface composed of stone, gravel, sand, shell or slag, or combinations thereof, and bituminous materials incorporated together by mixing methods.

Bituminous gravel pavements are those composed of gravel and bituminous materials incorporated together by penetration methods.

Bituminous macadam pavemens are those consisting of broken stone and bituminous materials incorporated together by penetration methods.

Bituminous surfaces consist of superficial coats of bituminous materials with or without the addition of stone or slag chips, gravel, sand or materials of a similar character. This definition was proposed in the 1912 Report of the Special Committee on "Use of Bituminous Materials in Road Construction" of the American Society of Civil Engineers.

Sheet asphalt pavements are those having a wearing surface composed of a predetermined graded sand, fine material and asphalt cement incorporated together by mixing methods. Although this definition embodies the ideas of the leading authorities and covers common usage, it has been inserted because it has been claimed that a bituminous concrete containing as part of its mineral aggregate broken stone passing a ½-inch sieve and retained on a ¼-inch sieve should be classified under sheet asphalt pavements. Fortunately this assertion has not been received with favor by municipal engineers.

In order to give some idea of the extent of the use of bituminous materials in the construction of roads and pavements in the United States, the superficial yardage of roads maintained by surface treatments, of bituminous pavements constructed by penetration methods, and of bituminous concrete pavements built under the jurisdiction of the State Highway Departments of Maine, New Hampshire, Massachusetts, Rhode Island, New York, New Jersey, Pennsylvania and Maryland during 1911 is given. In the following table the yardage for 1908, 1909 and 1910 is included for comparison:

SURFACE TREATMENT OF ROADS.

	Tars and Tar-Asphalt Compounds.	Medium and Heavy Asphaltic Oils and Asphalt Cements.	Light Asphaltic Oils.
1908	57,700	239,500	.....
1909	95,500	910,600	4,125,900
1910	123,400	2,434,200	9,890,400
1911	433,700	7,980,400	3,765,200

BITUMINOUS PAVEMENTS CONSTRUCTED BY PENETRATION METHODS.

1908	37,800	25,200	.....
1909	170,200	2,077,400	.....
1910	339,300	4,840,200	26,500
1911	121,900	8,680,900	.....

BITUMINOUS CONCRETE PAVEMENTS.

1908	52,100	4,400	.....
1909	136,000	219,500	.....
1910	158,000	432,600	.....
1911	24,400	508,100	.....

As under the Rhode Island State Board of Public Roads no construction work was accomplished during 1911, due to the fact that no road appropriation was made by the Legislature, the yardage of bituminous concrete pavements constructed with tar and tar-asphalt compounds in 1911

*From a paper before Section D of the American Association for the Advancement of Science.

shows a decrease in comparison with the yardage recorded for 1908, 1909 and 1910, the bulk of which was built by the Rhode Island Board. It is of interest to note, however, that 750,000 gallons of refined tar have been ordered to be used in the construction of bituminous concrete pavements in Rhode Island during 1912. That more permanent forms of construction are favored by our State Commissions is clearly shown by the marked decrease in the use of light oils for surface treatment of roads and the decided increase in the surface treatment of roads with heavy asphaltic oils and asphalt cements. As showing the general increase in the use of bituminous surfaces and bituminous pavements from 1908 to 1911, the total figures for the four years are given. The total number of square yards for each of the above years is given in the following table:

1908	416,700
1909	7,735,100
1910	18,244,600
1911	21,514,600

These totals include the yardage of road surface treated with light asphaltic oils. A comparison of more value and representing material progress along the lines of improved methods of construction and maintenance should be based on totals from which the yardage of road surface treated with light asphaltic oils is omitted. On this basis the total yardage is as follows:

1908	416,700
1909	3,609,200
1910	8,327,700
1911	17,749,400

As noted above, one line of development in the surface treatment of roads has been the departure from the use of palliatives and a marked increase in the use of bituminous surfaces. This tendency is due in part to the unsatisfactory results which have accrued from using bituminous materials which did not "set up" in from 24 to 48 hours, to the necessity for repeated closing of thoroughfares and to the recognition on the part of many that bituminous surfaces are more economical and efficacious in the long run than treatments with palliatives. This change is not only characteristic of state work, but is even more characteristic of municipal work where the tracking of bituminous materials results on the whole in more material damage to property.

The second marked development under bituminous surfaces is in the increased use of various types of pressure and gravity distributers which have been specially designed for this work. The consequent abandonment of the use of pouring cans and ordinary watering carts for this work is to be commended. Many types of these machines have been used during the past year for this kind of work. It has been unfortunate that sufficient information has not been at hand covering the use of these various machines so that an engineer might know the limitations of a machine before purchasing. It is self-evident that, given the kind of bituminous material, the temperature of the material, the rate at which the distributer travels, the calibration of the distributer should be such that the operator will know how much it will distribute per square yard. Information of this character will, without doubt, be forthcoming with reference to many of the distributers to be used during the season of 1912. Extravagant claims have been made by the designers and manufacturers of distributers. In a certain instance it has been claimed that materials, ranging in character from light oil to an asphalt cement of a consistency suitable for use in the construction of sheet asphalt pavements, could all be distributed by a given machine in amounts per square yard varying from one-eighth of a gallon to two gallons. Recently the writer's attention was called to the fact that a certain designer was recommending the use of a pressure distributer, which necessitated the use of a steam roller in its operation, for the distribution, as a surface application, of a palliative which is always applied cold.

During 1911 bituminous surfaces have not only been used extensively on macadam and gravel roads, but they have also been used to a considerable degree on cement-concrete pavements. The improvement of the concrete pavement by the addition of the bituminous surface is marked, as, if the proper kind of bituminous material is used, the pavement is nonproductive of dust, is not slippery, and is less noisy than the ordinary concrete pavement. There is no apparent reason why the results accruing from the use of bituminous surfaces on brick pavements would not be equally good. Especially would such be the case where bituminous fillers are used, thus combining many of the advantages of bituminous fillers and bituminous surfaces with the inherent good qualities of brick pavements.

In the field of the construction of bituminous pavements by penetration methods, the numerous methods which have been employed during 1911 will be described. All these methods have as the principal desiderata the keeping of the bituminous material within 2 inches of the road surface and the securing of the uniform incorporation of the bituminous material and the broken stone. Due to the lack of uniformity in the density of the surface and in the amount of bituminous material applied by the many methods employed, it is obvious that the uniform incorporation of the road metal and the bituminous cement is difficult to

obtain. The average pavement has been generally built in two courses, the foundation course being about 4 inches thick after rolling and the top course about 2 inches thick after rolling. Following are brief descriptions of the various methods to which reference has been made. In all the methods the construction is completed by the application of a thin coat of sand, stone chips or screenings:

Type A.—For the upper course broken stone is used containing sufficient small-sized particles to materially reduce the voids, as, for instance, crusher-run stone, which passes a 1½-inch screen and is supposed to be retained on a ½-inch screen. In this method, after the upper course is laid, the bituminous material is applied either before or after the surface is rolled, some favoring the former, because of the greater depth of penetration secured. When the upper course is rolled after the application of the bituminous material, a coat of mineral matter has usually been spread over the surface before rolling. The necessity for a second application or seal coat of bituminous material is determined by traffic conditions in many cases, although standard practice in some departments is responsible for the use of one or the other method, independent of the traffic.

Type B.—In case the metal of the upper course is a uniform product of about 1 inch or 1½ inches in size, the bituminous material is applied after the course has been lightly rolled. Stone chips are then spread upon the surface and thoroughly rolled. After the surface is broomed, another coat of bituminous material is applied. The above method is also used when the road metal varies from 1½ to 2½ inches, in which case ¾-inch stone is usually employed in place of chips.

Type C.—The foundation courses are filled to a certain extent with sand or small-sized broken stone and after the course is rolled, excess mineral matter is swept off. After the upper course of road metal is applied, its voids are filled to within about 1 inch of the surface and the bituminous material applied. The road is finished with a coat of sand or chips which is rolled, although in some cases a second application of bituminous material and chips is used.

Type D.—A closely packed foundation or a concrete base is used and large and uniform-sized stone employed for the wearing course. In this method a layer of sand, ¾ of an inch thick, is placed on the bottom course and bituminous material distributed, using about one gallon per square yard. The upper course of metalling is applied and the upper course thoroughly rolled, the bituminous mastic tending to fill the voids of the upper course. Another coat of bituminous material is applied and the surface finished by the application of a coat of chips or two applications of bituminous material are made, using likewise, two coats of sand or chips.

Type E.—The upper course is constructed in the usual manner and in place of sand or stone chips, a bituminous mastic is applied to the surface, being rolled into the voids and forming the finished surface of the road.

The remarks pertaining to distributing machines mentioned in connection with the discussion on bituminous surfaces apply with equal force to types of distributers used in the construction of bituminous pavements by penetration methods.

The construction of bituminous concrete pavements in connection with which broken stone is used in the aggregate has been developed along certain lines during 1911, although fear of litigation has restrained many engineers from advocating the use of this type of pavement. Instances of development in this field of construction will be cited in connection with each of the types of bituminous concrete pavements to be considered later. Although it is not intended to draw up a brief, nevertheless it may be of interest to include in this resume reference to certain specific cases of the early use of each type of aggregate.

Bituminous concrete pavements, in the aggregates of which broken stone forms an integral part, may be divided into three groups, as follows, the classification being based upon the character of the mineral aggregate:

Type A.—One size crusher-run stone, that is, any one product of a crushing plant.

Type B.—Combinations of one size crusher-run stone and fine mineral matter, such as sand, stone screenings and fine gravel.

Type C.—Finely-graded aggregates of broken stone and sand or other mineral matter.

Naturally Type A has been very popular due to its inherent simplicity. During the past year the writer has seen excellent pavements constructed by this method where the aggregate was a one size crusher-run stone, having the following characteristics based upon a mechanical analysis; all the stone passed a 1¼-inch sieve; not over 25 per cent. passed a 1¼-inch sieve and was retained on a ¾-inch sieve; and not over 5 per cent. passed a ⅛-inch sieve. Descriptions of old pavements of this type are legion. As an illustration may be cited the following specification used in England prior to 1899: "The hot stone, when ready for mixing, is screened into material of three sizes, 1 to 2 inches for the body, ½ to 1 inch for the intermediate coat, and ¼ to ½ inch for the top dressing. The coarsest material is used in a layer 3 to 4 inches thick,

the intermediate size forms a coat of about ¾ of an inch, and the top dressing is used in thinnest layer possible, with a view to filling all interstices. Afterward a dressing of ¼ inch and smaller granite screenings is scattered broadcast, and the traffic at once allowed on the road to work this top dressing into the tarred material. Each of the layers is rolled separately with a 10-ton roller."

The State Board of Public Roads of Rhode Island has used Type A since 1906. It has been admitted in writing by certain patentees "that so long as the construction is of the nearly uniform sizes of stone which you are now using, and you do not get the fine material applied from the surface or into the spaces between the particles of bitumen-coated stone more than our observations indicate you are now doing, or we believe it is possible to do, we would not claim this feature of the construction to be an infringement of our patent No. 727,505." The construction referred to in the above quotation covers the construction of a wearing course of a bituminous concrete pavement under the following specification relative to the broken stone: "The bottom course shall consist of stone from one and one-quarter (1¼) inches to two and one-half (2½) inches in their longest dimension, the upper course of stone from one-half (½) to one and one-quarter (1¼) inches in their longest dimensions." Only the upper course stone was mixed with bituminous material. The product of the crusher which met this specification was obtained from the ordinary type of crushing plant, the broken stone usually passing a 1½-inch screen and commercially being retained upon a ¾ or ⅝-inch screen. A mechanical analysis of a typical product used in Rhode Island may be of interest, and hence, is given below:

Per cent. passing 10-mesh sieve 1.0
Per cent. passing ¼-inch sieve..... 2.5
Per cent. passing ½-inch sieve 30.8
Per cent. passing ¾-inch sieve 34.2
Per cent. passing 1-inch sieve 23.4
Per cent. passing 1¼-inch sieve 8.1

As Deputy Engineer for the State Board of Public Roads of Rhode Island, the writer had charge of the construction and maintenance of bituminous surfaces and bituminous pavements for a number of years, and hence had the opportunity to inspect on numerous occasions the first section of bituminous concrete pavement constructed in 1906 under the above specification. This section has needed no repairs, although subjected to high speed motor car traffic of the heavy passenger type. Without doubt, broad-minded judges would admit that this type of pavement has inherent stability.

The second type, that is, one having an aggregate composed of one size crusher-run stone mixed with fine material such as sand, screenings or material of a similar character, is likewise described many times in early technical literature. For example, the following description was published over thirty years ago: "The manner of preparing, treating and laying the asphalt mass is as follows: He took asphalt, 125 parts; petroleum oil, 25 parts. These substances were melted and thoroughly incorporated together, and to this mixture he added, in a heated state, sand or powdered stone, 750 parts, and gravel or broken stone, also heated, 1,100 parts. The whole was then horoughly mixed."

During 1911 Type B was popular in various quarters. Washington, D. C., under the jurisdiction of Captain Mark Brooke, of the Office of the Engineer-Commissioner, bituminous concrete pavements were constructed under the following specifications, covering mineral aggregate: "The paving materials shall be composed of crushed trap rock screenings, concrete sand and mineral dust in the following proportions: Trap rock screenings, two parts; concrete sand, one part, and mineral dust, at least 5 per cent. of the above aggregate, mixed with asphaltic cement." The trap rock screenings referred to above varied in size from one inch to screenings and were devoid of dust. Detailed specifications were also given with reference to the character of the sand and the mineral dust. The writer has had the good fortune to examine various streets paved under the above specifications. In his humble opinion these pavements possess inherent stability under commercial traffic.

In connection with the discussion of the use of the third type, that is, a graded aggregate of broken stone with or without sand and fine mineral matter, the consideration of the following description, so old as to be covered with the dust of decades, is apparently pertinent: "Broken stones are preferred for the whole pavement, and shall alone be used for the covering. The greatest dimension of stones for the base (except as hereinafter noted) shall be between three inches and one-fourth inch, and for the covering between two inches and one-twentieth of an inch; the sizes shall be mixed in proportion, varying with the size to form a close mass, which, when dry and compact, can absorb not more than 20 per cent. of water."

During 1911 many thousands of yards of a pavement of Type C have been laid. In the borough of Richmond, New York City, over 40,000 square yards were laid on a total of eighteen streets last year under direction of Theodore S. Oxholm, M. Am. Soc. C. E. The mineral aggregate used conformed to the now famous Topeka specifications. A decree was signed by certain officials and representatives of certain patentees covering the

use of the Topeka mineral aggregate. The following quotation is from the decree to which reference has been made: "It appearing to the court that of the mineral matter used in the pavements actually constructed in the cities of Topeka and Emporia, Kas., no particles of stone were used that would not pass a screen with openings one-half an inch in diameter, and that less than 10 per cent. of the stone or coarse sand used would be retained upon a screen with openings one-fourth inch in diameter, and the remaining mineral matter used being finer than one-fourth inch; and it further appearing that pavements constructed by the use of mineral particles as above described do not infringe the claims of complainant's patent No. 727,505, sued upon in this case; and it further appearing that the pavements actually constructed in the cities of Topeka and Emporia, Kas., do not infringe the claims of complainant's patent No. 727,505, sued upon in this case, and that any pavement hereafter constructed in substantial compliance with the following formula, to-wit: Bitumen, from 7 to 11 per cent. Mineral Aggregate—Passing 200-mesh screen, from 5 to 11 per cent.; 40-mesh screen, from 18 to 30 per cent.; 10-mesh screen, from 20 to 55 per cent.; 4-mesh screen, from 8 to 22 per cent.; 2-mesh screen, less than 10 per cent; sieves to be used in the order named, would not infringe the claims of said patent."

Mention should be made of the effect of the introduction of various types of low-priced mixing machines during 1911. The economical and satisfactory results accruing from the use of these machines for mixing certain types of aggregates with bituminous cements has caused the introduction of the mixing method in many localities where only the penetration method has formerly been hsed. During the season of 1912 many new machines of this type will be used with the consequent increase in the construction of the various types of bituminous concrete pavements outlined above.

During 1911 considerable thought has been devoted to the methods and materials employed in the construction of sheet asphalt pavements. Notable work has been done by a special committee of the American Society of Municipal Improvements and the committee of the Association for Standardizing Paving Specifications. Throughout the United States there appears to be crystallizing a firm belief that specifications for materials should be opened to admit such asphalt cements as "Bermudez," "California," "Pioneer," "Texaco" and "Trinidad," for instance, which have shown by service tests that excellent pavements may be constructed by their use. This tendency is commendable, as thus competition is increased and the high quality of the asphalt cement is maintained.

Construction of Asphalt Macadam in Webb City, Mo.

By E. W. Robinson, Assistant City Engineer.

OF THE forty miles of streets in Webb City more than 25 per cent. have been brought to grade and improved in some manner. Brick block is the only so-called permanent pavement that has been constructed up to the present time, and that only on the streets and alleys in the business section. The rest have been improved by some form of macadamizing or graveling, depending upon the cost that is desired. The property owners abutting upon a proposed street improvement pay the entire cost of the work in proportion to the frontage of each lot, as provided by the Missouri statutes for cities of the third class. Also a majority of the resident owners owning a majority of the frontage may kill any such improvement by filing a remonstrance with the city clerk within ten days of the date of the last publication of the resolution declaring such work necessary to be done. So it will be seen that the owners can, and do, set the limit which any improvement may cost, and it is up to the engineering department to get the best possible pavements within the required limit.

Up to within the last four or five years good results were secured with ordinary water-bound macadam, and what is known locally as "gravel pavement," which is nothing but a six-inch surface of mine "tailings" on a prepared sub-grade. Owing to the abundance and cheapness of the stone this class of pavements was secured for 30 to 40 cents per square yard, including excavation. But as soon as automobiles, motorcycles and motor trucks came into common use it was noticed that surfaces that heretofore were hard and smooth commenced to ravel and mud holes became frequent. Also considerable trouble was always experienced with washing on grades steeper than 3 per cent. owing to the fact that the local rock does not bind as well as limestone or other road metals.

The problem then was to get a cheap pavement that would withstand these new influences, and naturally macadam, with a bituminous binder, presented itself as the more acceptable. There had previously been two streets improved with a patented process consisting of mixing the top six inches of the soil with a heavy asphaltic oil and compacting with the rolling tamper. One was a fair success and the second was almost a complete failure, especially at a cost of $1 per square yard, which the property owners paid. It seems that the soil in this locality does not lend itself to that method of treatment.

Before going into details of the method of construction it might be well to give a brief description of the nature of the stone used. Practically all the rock in the immediate locality is a hard blue and white flint, which breaks with a smooth fracture and with about as much binding quality as glass. Limestone occurs at no regular depth or thickness and its use would put the cost of the work completely beyond what the people are willing to pay. The flint used for road and concrete purposes consists of boulders, rip-rap and tailings from the lead and zinc mines of the district. The boulders and tailings occur in large piles at the mills in every direction and can generally be had for the hauling. The rip-rap is of smaller size than the boulders and varies more in size and quality than either the boulders or tailings and is found generally around shafts that have been put down to prospect a lease. Suitable material can generally be had for any work in the city with a haul from one-eighth to three-fourths mile, that is, if any of it could be called suitable. The tailings (commonly called gravel) varies in size from one-eighth to three-fourths inch, the proportions of each size varying from different mills and from different places in the same piles. This is the material used for the concrete work, and is used for filler and surfacing the macadam.

Asphalt macadam was started here in 1910, and about 26,000 square yards were constructed that year. The method employed was substantially as follows: The sub-grade was prepared six inches below the finished grade and rolled with a 15-ton macadam roller until thoroughly solid. The combined curbs and gutters were then covered with about all the tailings that would stay on them. This was to protect the concrete from becoming spattered with the binder and to be used in covering the surface before rolling. On the sub-grade was placed a five-inch base of rip-rap and small boulders, broken so that none would measure more than five inches in any direction. If the larger rock was in excess tailings were used to fill the voids and this base was rolled and compacted as much as possible. On this base was spread the asphalt binder at the rate of three-fourths gallon to the square yard at a temperature between 160 and 350 degrees Fahrenheit. This was covered with a thin layer of tailings and another coat of asphalt applied at the rate of one-half of a gallon to the square yard. This was covered thoroughly with tailings and rolled as soon as possible and until a smooth surface was obtained or the surface showed that further rolling was detrimental. As all the work was done by local concerns the city roller was used. Undoubtedly better results could have been secured had a ten-ton tandem roller been used on the surface instead of the fifteen-ton macadam roller. On the first job the asphalt was applied with a tank wagon, but this was abandoned for the rest of the work for the reason that it was almost impossible to spread the binder evenly. The wagon was not fitted for heating and keeping the material hot and trouble was experienced in that direction. The rest of the work was done by the hand method, using two-gallon sprinkling can fitted with special flaring mouth so as to give a flat stream. The contract price for this work ranged from 48 to 77 cents, depending upon the excavation, the average being 60 cents. These streets have stood up well under the traffic, considering of course the price paid for them. However, the last job put in that year always has been somewhat rough, owing to the fact that nearly all the good rip-rap had been used for the other work, and what was obtained was not well graded, with the consequence that large rock keep working to the surface.

In starting to lay out the work for 1911 it was seen at once that it would be necessary to have rock crushed especially for this purpose. The city made arrangements to install a crusher, but refrained from doing so after a private concern agreed to install one and furnish rock at reasonable price to all contractors who should be awarded contracts for paving. The specifications were then changed and provided for a four-inch base of rock not larger than four inches and graded to make as few voids as possible. On this base was placed a two-inch wearing surface of rock not larger than two inches and with no tailings added. After this course was ironed out with the roller one coat of asphalt was applied at the rate of two gallons to the square yard and at a temperature between 300 and 350 degrees Fahrenheit. This was then covered with about one inch of tailings and thoroughly rolled. This produced a much better construction, and the cost varied from 65½ to 83 cents, with an average of 73 cents. There were 27,500 square yards of this work

done in 1911, some in the business part of the city, and so far is standing the traffic well. Considerable of this work was done later in the fall with the consequence that the cold stone chilled the asphalt and it did not get thoroughly distributed. This caused some raveling during the winter, but the spring sun is putting them in good shape. The experience here with this kind of rock is that it takes about one summer's sun and traffic to distribute the binder properly and settle the rock so that no further raveling takes place.

On the work done in 1910 only one asphalt kettle of 500 gallons capacity was used to heat the asphalt. This was pulled ahead as the work progressed by a team kept on the job for that and hauling the asphalt from the place of unloading to the street. In 1911 the roller was kept on the job continuously and was used to pull two 500-gallon kettles, and in this manner the asphalting was done much more rapidly than formerly. Also in 1911 special three-gallon pouring cans were used. It was discovered that the direction of the wind had considerable to do with the heating ability of the kettles, and considerable time was lost on account of not being able to keep hot asphalt for the pourer. Also when the men were not careful and got much foreign matter in with the asphalt it formed as a cake on the bottom of the kettle and lessened the amount of asphalt it would heat. There were three brands of asphalt used, one was shipped in tank cars, another in wooden barrels and the other in steel drums. The staves from the wooden barrels furnished all the fuel necessary when that material was used. During hot weather, after the staves or steel drums had been removed, the asphalt was cut into suitable sized pieces to put into the kettles by one man using a wire with a piece of wood for handle at each end. During the colder weather it was necessary to use a regular cutter made for that purpose.

An inspector was kept on the job continuously after the asphalting started. A constant check was kept on the amount of binder used by counting two or three times a day the number of cans poured in a stretch of 10 or 15 feet, as well as counting the number of barrels used and amount covered during each day. The organization of the asphalting gang varied with different contractors, but was substantially as follows for the work done the more economically: One foreman, one man pouring asphalt, one man carrying asphalt to pourer (two cans being used), two or three men cutting and placing asphalt in kettle and firing, two men spreading gravel, and at times helping fill kettles; water boy, who also helps fire kettles, night fireman to have kettles full of hot asphalt for morning. A gang of this size would on days when everything went all right cover 1,200 square yards in ten hours, but 900 square yards was a good average for the whole job. The following data give the cost of the asphalting on four different jobs, two for the work done under the 1910 specifications and two under the 1911 specifications:

No. 1—6,547.2 square yards, October, 1910—

	Cost per square yard.
Foreman, 77 hours at 55 5/9c...	$0.0065
Fireman, 119 hours at 22 2/9c...	.0040
Carrying and pouring asphalt, 99 hours at 22 2/9c.....	.0033
Spreading gravel, 133 hours at 22 2/9c	.0045
Cutting and placing asphalt in kettles, 112 hours at 22 2/9c, 11 hours at 44 4/9c.....	.0045
Team hauling asphalt and pulling kettles, 37 hours at 44 4/9c...	.0025
Asphalt, 32.48 tons at $20.20 f. o. b. Webb City.....	.1002
Total cost per square yard....	$0.1255

Average square yards per hour for whole job, 85.

No. 2—5,090.4 square yards, November, 1910—

	Cost per square yard.
Foreman, 54 hours at 38 8/9c...	$0.0037
Fireman, 100 hours at 22 2/9c...	.0039
Carrying and pouring asphalt, 64 hours at 27 7/9c.....	.0031
Spreading gravel, 136 hours at 22 2/9c	.0053
Cutting and placing asphalt in kettles, 60 hours at 22 2/9c....	.0023
Team hauling asphalt and pulling kettles, 26 hours at 38 8/9c.	.0018
Asphalt, 32.25 tons at $20.20 f. o. b. Webb City.....	.1145
Coal, 2 tons at $4.....	.0014
Total cost per square yard...	$0.1360

Average square yards per hour for whole job, 105.

No. 3—7,893 square yards, September, 1911—

	Cost per square yard.
Foreman, 57 hours at 40c.....	$0.00289
Carrying and pouring asphalt, 114 hours at 20c.....	.00289
Cutting and placing asphalt in kettles and firing kettles, 206 hours at 20c.....	.00522
Spreading gravel, 78½ hours at 20c	.00199
Night fireman, 45 hours at 20c, and water boy, 57 hours at 7½c	.00168
Hauling asphalt, team and two men, 42 hours at 55c.....	.00293

Asphalt, 64.879 tons at $20.20, f. o. b. Webb City..... .16604

Total cost per square yard....$0.18364

Average square yards per hour for whole job, 138.

No. 4—3,921 square yards, September, 1911—

	Cost per square yard.
Foreman, 27 hours at 40c.....	$0.00275
Carrying and pouring asphalt, 54 hours at 20c.....	.00275
Cutting and placing asphalt in kettles and firing kettles, 59 hours at 20c.....	.00301
Spreading gravel, 68 hours at 20c	.00347
Water boy, 22 hours at 7½c, and night fireman, 30 hours at 20c.	.00195
Hauling asphalt, team and two men, 28 hours at 55c.....	.00393
Asphalt, 32.665 tons at $20.20 f. o. b. Webb City.....	.16830
Total cost per square yard....	$0.18616

Average square yards per hour for whole job, 145.

Receptacles for Street Sweepings and Washings.

By Dr. Robert Grimshaw, Dresden, Germany.

THE problem of collecting and removing kitchen waste, ashes, etc., is one the solution of which has given much trouble to "city fathers" and others in all quarters of the world where one is not hardened to dirt, disease and stench. There are countless ways of doing the work so as not to offend eye or ear and without encroaching too seriously on the municipal or private pocketbook. There is, however, only one way of not doing it, and that is common to every quarter of the globe. One system adopted in several cities is illustrated herewith. The inventors have given it the name of the "Augias," whereas I should have called it the "Herakles"; for it was his fearless and enterprising example of muscular paganism which first distinguished him as a scavenger.

The arrangement for use in collecting dry street sweepings and the like is shown in the accompanying illustrations and consists of sunken receptacles in the street pavements, closed by a double cover, which may be partly opened for the street sweeper to add his quota or entirely to permit the removal by hand cranes of the entire contents from the sheet metal box which neatly fits the excavation.

Fig. 1 shows the cover closed; Fig. 2 partly open for the reception of dirt, and Fig. 3 fully open for the removal of the box, which is being removed by crane attached to the garbage or offal cart, into which the box will be emptied.

The excavation, which is 48 inches deep, 30x26 inches in the opening, is lined with reinforced concrete, this lining being in one piece and weighing about 785 pounds. The cover weighs 72 pounds, the inner receptacle, which is 1.5 millimeter, or, say, .06 inch sheet iron, weighs about 13 pounds.

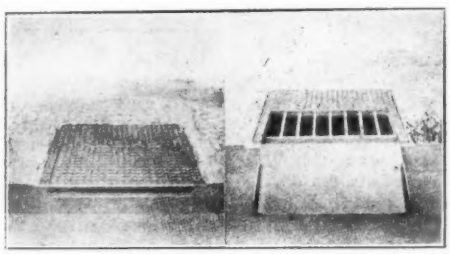


Fig. 1. Fig. 2.
RECEPTACLE FOR STREET SWEEPINGS.

Since the introduction of asphalt and the like for street paving and of sprinkling wagons in connection with mechanical sweepers and "squeegees" for the purpose of removing all the dirt by the wet process and carrying it off through the sewers, it has been found necessary in many cities where the sewer system is defective to provide "gullies" or receptacles for the street washings. These must be of considerable dimensions on account of the large proportion of water to the solid matter. Clearing out such sinks or gullies by hand dipping is expensive and unsightly; also not always exactly suggestive of "perfumes of Araby the blest." Attempts to empty them by pumping have showed that only the upper layers of water and thin mud can be cessitating subsequent dipping.

The method introduced by the Augias Company of Berlin into several German cities consists in using "gullies" such as shown in vertical section in Fig. 4, permitting the removal of lower layers also by pumping by the very simple process of drawing all off from the bottom and making the entire mass of only one consistency.

Fig. 3.
RECEPTACLE FOR STREET SWEEPINGS.

removed; the more solid under layers refusing to enter the suction pipe, and ne-

The gulley or receptacle consists of a main portion with suitable upper and lower gratings to permit the entrance of the sweepings, etc., and a side outlet where desirable. The lower portion of the receptacle is conical, and from it there rises a suction pipe, the upper end of which may be put in air-tight communication with the lower end of the suction hose of the ordinary pump employed for such material, and which delivers the latter to the usual tank wagon, as shown in the illustration.

Tests go to show that the removal of a cubic meter (35.3 cubic feet) of average contents of such a receptacle takes but two minutes after all is coupled up and going.

The process has the advantage of being rapid, sightly and cleanly, besides being cheaper and more thorough than hand work.

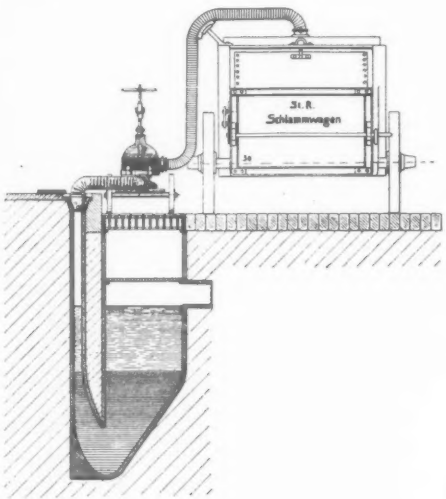


Fig. 4.
RECEPTACLE FOR STREET WASHINGS.
Pump Attached for Removal to Tank Wagon.

Nomenclature of Creosote and Creosoting Oils.*

By David Allerton, Portland, Oregon.

CREOSOTE seems to have been originally adopted in England as the synonym for dead oil of coal tar, and the product was first called dead oil because its specific gravity was greater than water; at least that was the reason given when I first became acquainted with it so many years ago that I hate to state the exact number for fear I may be accused of alluding to prehistoric times. When first used for preserving wood it was simply creosote, and when it was found necessary to define it by a certain specification, and not much being known about it at the time, except that it contained tar acids and naphthalene, a specified amount of these constituents was required as well as a specific gravity greater than water. Afterwards, as more chemical work was done in coal tar derivatives, creosote oil being, as we all know, separated from the crude tar, light oils, etc., by distillation, a process of analysis by fractional distillations was devised, the original object being to determine that the creosote had been obtained from crude bituminous coal tar; also a specific gravity greater than water, at least 1.02 and upward was required. This fractionation was so graded as to eliminate the very light oils and water and leave only an inconsiderable residue at the end of the process. At first the distillation was not usually carried above 310 or 315 C., but afterward as high as 354 degrees, when only a very small

*From a paper and discussion before the American Wood Preservers' Association.

amount was allowed to remain in the retort. The method of distillation was also standardized, and that method still obtains, the oil complying with certain requirements in a general way. I have not given the intermediate fractions, as they are well understood; and it is also equally well understood that an allowance must be made for a variation, due to the difference in the quality of various bituminous coals, as well as to the method of the original destructive distillation of the coal, and also the variations due to the method of analysis. There seems to be no doubt that all pure tar creosotes are good wood preservatives, even if they vary to some extent. It is evident that the less the viscosity of a liquid, either an oil or an aqueous solution, the easier it is forced into wood fiber, and that in treating refractory wood it is desirable to have a preservative of a very low viscosity. Of course, experience has long ago taught us that it is impossible to get an exactly even penetration in any charge of timber or ties, and the greater the viscosity the greater the variance; this extreme viscosity, and often the incompetency of the operator, is the cause of the complaints now being made as to the great difference in the penetration of the compound used in the timber or ties, in a given charge, of course, and it is well understood that a proper regulation of temperature and pressure is necessary to get a fairly even treatment, but with a lighter bodied oil, careful handling by the operator is not quite so necessary or important.

In quite recent years so-called standard specifications have been adopted by different associations, defining the specifications for creosote to be used in the treatment of ties and timber, as well as paving blocks, and the specifications define the gravity, usually giving a very high lower gravity and distillation points calling for an addition of coal tar or pitch (it seems to be known by both terms), but viscosity is lost sight of, although but a limited amount of insoluble matter (otherwise carbon) is permitted, it being assumed that no matter how thick and heavy the liquid is it can be made to penetrate wood if it contains no insoluble matter. This is fallacious. At first it was not definitely stated what the creosote was to contain, the required analysis only being given and allowing a large, and, in the paving mixture, a very large, residue above 354 degrees, merely stipulating that this residue should be soft; with American creosote it is always hard, but that does not seem to matter. Now, these mixtures are not what was originally meant by the term creosote, and I think that they should have been defined as to what they should contain besides the dead oil. Of course, the inventors of these heavy mixtures considered them a great improvement on the lighter preservatives, and they were governed by purely altruistic motives, we will admit. But I know from experience that it is very hard to get a penetration of any depth with these bodies of such viscous nature, most of the mixture remaining on or near the surface.

The cause for the excessive oozing of the oil, commonly called bleeding, from paving blocks, can be traced very simply to the use of such oils, as when they are treated with creosote this bleeding is very slight and increases with the weight of the oil.

Now, using crude coke oven tar as a basis, which contains somewhere about 30 per cent. of creosote, this material contains all the preservative necessary, as 30 or 40 per cent. of creosote is amply sufficient in any preservative mixture where a neutral body is used, either as a matter of economy or for some other purpose, such as increasing the waterproofing qualities, though this last is of doubtful advantage as compared with its disadvantages.

Coal tar is inert matter as regards preservative qualities and is used in creosoting for precisely the same purpose as barytes is used in paints, its objections being, as I have before stated, its high viscosity; but at present there seems to be no substitute on the market, and there is in some quarters a return to creosote as formerly used by those who have tried the heavy mixture; but undoubtedly the combined creosote and tar will still be used, and the purpose of this paper is to suggest a correct appellation of the various creosoting mixtures and creosotes.

I propose the dead oil of coal tar be designated as creosote; other creosotes, such as wood creosotes, oil tar creosote, etc., be so designated, and the mixtures of creosote with coke oven tar, filtered tar, or oil tar, etc., be designated creosoting oils, and the specifications for such oils to call for the per cent. of creosote contained and the per cent. and kind of matter added.

I trust that this is a conservative exposition of the subject and that it is not unworthy of consideration by your honorable body. A correct nomenclature would do away with any misapprehension or ambiguity of expression or the use of unnecessary terms; we know how the meaningless term, "chemically pure," has been used, and to say that an oil is a product of pure coal tar or a pure coal tar product is equally incorrect, for it might mean that the substance was coal tar or coal tar creosote, or that it merely contained a certain amount of either, and it is to the interest of producer and consumer to have a product properly defined.

In the discussion of the paper Mr. S. R.

Church said: "I would like to say that I am in sympathy with Mr. Allerton's desire to have a correct system of nomenclature for oils used in timber preservation. There is one statement in Mr. Allerton's paper that perhaps deserves a word of explanation. He says that coal tar is inert as a preservative, and simply acts as a filler. Now, creosote oil is derived from coal tar, and if you use the tar itself, for the sake of argument suppose you use the straight tar, you would have there at least 40 per cent. of creosote oil in your tar, and to that extent it cannot be true that coal tar as a preservative is inert. The distilled tar usually contains most of the creosote. The oils removed by the distillation would be the lighter oils and the water, and not, properly speaking, creosote."

Metering the Louisville, Ky., Water Supply.

THE constantly increasing demand upon the available water supplies of all cities, not as fortunately situated as to have an inexhaustible supply, taken with the recurring menace of a water famine, has caused more attention to be directed towards the question of preventing the waste of water. Even New York City, with its immense water supply awaiting delivery by the completion of the Catskill aqueduct, last summer was brought into imminent danger of a water famine, due to the waste caused by leaks and careless use by all classes of consumers.

The installation of meters on the service supply in a great number of cities has resulted in a reduction of the careless, and it ought to be said, criminal waste of water. It is interesting to note in this connection that the general adoption of meters has been only after a continued use of a small number of meters which are increased each year, and after the education of consumers to the benefit of their use. This process of education has taken various methods in different cities. In some cities publicity campaigns by the water officials have been sufficient to secure their adoption, while in others it has been necessary to force their adoption by legislation.

Washington, D. C., has been a notable example of this latter method. The marked opposition which was at first made to the adoption of water meters has in the space of a few years given place to a sentiment in favor of their use. The fact that the meter was found to be merely a safeguard against wanton waste; and, that its use did not mean excessive charges, has resulted in an entirely different attitude towards the metering of the supply. Those who use only that amount of water which is necessary feel that they are paying only that which is their portion, and that they are not being taxed to pay for water which other consumers waste.

In Philadelphia education has not reached the point where opposition to the use of meters has been removed. The water supply is owned and controlled by the city, and the opposition to meter installation has so far been successful. In fact, in 1904 an ordinance was passed which prohibited the use of meters, even in cases where the consumer requested an installation. The fact that, unless the water waste is checked, water works extensions will be necessary in the near future has resulted in an effort to have the ordinance revoked.

Louisville, Ky., which has a very efficiently managed water works system, has proceeded along the line of gradual adoption of meters, and in the 1911 report of the Louisville Water Company, which is municipally operated, Theodore A. Leisen, the chief engineer, gives a discussion of the question of metering the supply, which sets forth clearly the advantages to be gained by the procedure.

The 1909 report of the Louisville Water Company shows a net increase of 170 in the number of meters in use, making the total number of meters only 2,642. The non-metered revenue at that time was $401,633, or about 57 per cent. of the total.

In 1910 the net increase in meters was 205, making 2,847 meters in use, and the non-metered revenue still continued at 57 per cent., or at this time $417,187. At this time attention was directed by Mr. Leisen to the fact that, though only 33 per cent. of the water supplied was metered, yet the revenue from the metered consumption was 43 per cent., proving that a waste existed, for which those having meters were charged.

During 1911 more attention was given to the extension of the metered supply, and a special meter department was established to systematize the work of installation and maintenance. Inspections were made, repairs were promptly attended to, and meters which were out of service were removed, so that at the end of the year there were only 2,800

meters in use. The comparison of the metered with the non-metered supply is given as follows:

	Gallons.	Per Cent.
Quantity of metered consumption	3,099,988,450	35.6
Quantity of non-meter-consumption	5,611,985,425	64.4
Metered revenue	$331,731.41	44.1
Non-metered revenue	420,159.41	55.9

As was noted in the previous year, the percentage of the metered consumption (35.6 per cent.) produced a greater percentage of revenue (44.1 per cent.).

A marked increase in the total consumption was noted in 1911, and Mr. Leisen, in his recommendations, states that the remedy for the situation lies in the metering of the supply. His discussion of the necessity of meter installation and the basis of charges which he proposes under the conditions of a metered supply are so well presented that they may be applied by water officials in other cities. His arguments are given as follows:

"The primary and most convincing argument in favor of selling all water by meter measurement is that the consumer pays only for what he actually uses, and in arranging for a meter schedule of rates this fact should be kept constantly in mind, and any scheme, however advantageous or simple, which departs from this principle will be open to more or less reasonable objection.

"No system of rates which ignores the necessity for a fixed minimum income from every service can successfully withstand the test of commercial requirements without making the unit rate for water excessively high, thereby working a hardship on the large consumer; but, on the other hand, the practice of establishing a minimum rate, which permits a predetermined quantity of water to be used under that rate—a system in vogue in this and many other cities—is objectionable for the reason that it nullifies the primal argument advanced for the adoption of the meter by deliberately charging the consumer for water which is not consumed in the majority of cases. As an instance, we charge a minimum rate of $36.50 per annum, which permits the consumption of 700 gallons per day. If the consumer only uses 350 gallons per day—an amount which experience has shown to be ample for the average dwelling—he is charged for double the water that he uses.

"Another undesirable feature in the tariff of meter rates prevailing in many cities is the sliding scale which discriminates against the small consumer, and, although commercially reasonable from the viewpoint of the water department, which can afford to supply in wholesale quantities at reduced rates, it is, nevertheless, unjust to the individual consumer.

"The first requisite of a proper system of rating is the production of a revenue sufficient for the operation of the plant in all its ramifications, including all necessary extensions and improvements. Assuming that the expenses for the next few years will be approximately the same as in the immediate past, and estimating the amount necessary for extensions, improvements, depreciation, etc., we have the following:

FIXED AND OVERHEAD OPERATING EXPENSES.		
Administrative and revenue	$65,000.00	
General expenses	40,000.00	
Distribution and general operation (50 per cent.)	25,000.00	
Interest	60,000.00	
		$190,000.00
PRODUCTION EXPENSES.		
Pumpage	$47,000.00	
Filtration	32,000.00	
Reservoirs	6,000.00	
Distribution and general operations (50 per cent.)	25,000.00	
		110,000.00
Total operating expenses		$300,000.00
CONSTRUCTION EXPENSES.		
Extension of mains 10-12 miles	$50,000.00	
New meters	50,000.00	
Other improvements	50,000.00	
Reserve for depreciation	25,000.00	
Surplus and incidentals	25,000.00	
		200,000.00
Total annual expenses or revenue required		$500,000.00

"A meter rate must, therefore, be arranged in such a manner as to produce not less than $500,000 annually.

"The overhead expenses, amounting to $190,000, exist independent of the quantity of water sold, and these fixed overhead charges should be met by a fixed income; and this it is proposed to do by means of a 'service charge' on each meter installed. There are 32,000 services in active use, and dividing this number into $190,000 would give $5.94 to be charged against each service. For convenience, it is proposed to establish this 'service charge' at $6 per annum for each ⅝-inch meter, $9 for ¾-inch, $12 for 1-inch, $24 for 2-inch, and on up to $72 for a 6-inch meter. If every tap were metered this 'service charge' would produce sufficient revenue to meet all fixed overhead charges and leave a safe contingent margin.

"The object in increasing the service charge in proportion to the size of the meter is two-fold. It makes a more equitable distribution of the charge, proportioning it to the service rendered, and it deters consumers from applying for a larger meter than is actually required. This 'service charge' would not cover the cost of any water consumed, but would take the place of a meter rental and serve the equivalent purpose of a 'minimum charge.' It covers the value of what is generally designated as a 'readiness to serve' charge, and, being based on the proportionate amount of fixed overhead charges, is figured on logical reasoning, and is not a mere arbitrary or haphazard charge.

"With this 'service charge' established as outlined herein, the water can be furnished to every consumer at exactly the same rate, regardless of whether he uses one thousand gallons or one million gallons; and this rate can be fixed at 4 cents net per thousand gallons, and within a few years it could probably be reduced, in which event we might claim, without fear of contradiction, that we were furnishing the cheapest water of any city in the country having similar conditions to contend with.

"To illustrate how this rate will work out in actual practice, a few cases are given with the old and the new rates:

L. & N. R. R. CO., 1911.		
Present Rate—17 meters, 345,139,916 gallons net		$16,145 52
Proposed Rate—"Service charge"	$882 00	
345,139,916 gallons at 4c	13,805 59	
		14,687 59
Reduction—9 per cent		$1,457 93
LOUISVILLE RAILWAY CO., 1911.		
Present Rate—21 meters, 210,801,586 gallons net		$10,104 81
Proposed Rate—"Service charge"	$696 00	
210,801,586 gallons at 4c	8,432 06	
		9,128 06
Reduction—9 per cent		$976 75
DWELLING—12-14 ROOMS, ¾-INCH METER.		
Present Rate—700 gallons per day, $36.50—25 per cent		$27 38
Proposed Rate—"Service charge"	$9 00	
700 gallons per day—255,500 gallons at 4c	10 22	
		19 22
Reduction—29 per cent		$8 16
DWELLING—7 ROOMS—30-FOOT LOT.		
Present Rate—General convenience and sprinkling	$26 10—25%	$19 58
Proposed Rate—"Service charge"	6 00	
300 gallons per doy—109,500 gallons at 4c	4 38	
		10 38
Reduction—47 per cent		$9 20

"The regular service charge of $6.00 per annum for a ⅝-inch meter, with a reasonable water consumption, would be a benefit only to dwellings whose flat or schedule rate exceeds $10.00 per annum, and in order to provide for metering very small dwellings, it is suggested that where the present rate is from $7.50 to $10.00 per annum, there shall be installed a so-called ½-inch meter with a service charge of $4.50, and where the rate is under $7.50 there shall be installed a so-

called ⅝-inch meter, with a service charge of $3.00 per annum. The latter charge would provide a rate of $4.46 with 100 gallons consumption per day, or $3.72 with 50 gallons per day.

"The average cost per annum for each metered dwelling, based on the quantities assumed in the estimates, would be as follows:

1-inch Meter—500 gals. per day,	$12	00	plus $7	40	equals $19	40
¾-inch Meter—400 gals. per day,	9	00	plus 5	84	equals 14	84
⅝-inch Meter—300 gals. per day,	6	00	plus 4	38	equals 10	38
½-inch Meter—200 gals. per day,	4	50	plus 2	92	equals 7	42
⅜-inch Meter—100 gals. per day,	3	00	plus 1	46	equals 4	46

"There is no guesswork in determining the rate which will have to be established to provide the revenue necessary for the operations of the plant. All figures have been derived from the conditions existing in 1911, the only estimates being the probable quantity of water which will be consumed through meters, and this is taken on a basis so conservative as to insure the final result being in excess of the estimates. The average daily quantity to each metered tap in 1911 was 3,033 gallons, and for each non-metered tap 526 gallons. In calculating the revenue to be derived from metering all of the present non-metered services, only 315 gallons per tap has been taken as the average quantity to be paid for.

"The following is the total estimated revenue which would accrue under the proposed schedule of rates, with every service metered, based on the present number of services:

SERVICE CHARGE.

PRESENT METERED SERVICE.

990—	⅝-inch at $6.00	$5,940 00	
339—	¾-inch at 9.00	3,051 00	
770—	1-inch at 12.00	9,240 00	
240—	1½-inch at 18.00	4,320 00	
256—	2-inch at 24.00	6,144 00	
104—	3-inch at 36.00	3,744 00	
64—	4-inch at 48.00	3,072 00	
37—	6-inch at 72.00	2,664 00	
2,800		$38,175 00	

PROPOSED METERS.

5,000—	1-inch at $12.00	$60,000 00	
5,000—	¾-inch at 9.00	45,000 00	
12,000—	⅝-inch at 6.00	72,000 00	
4,000—	½-inch at 4.50	18,000 00	
3,200—	⅜-inch at 3.00	9,600 00	
			$204,600 00
32,000—Meters—Total service charge			$242,775 00

WATER SUPPLY REVENUE.

PRESENT METERED SERVICE.

2,800 Meters—3,100,000,000 gals. at 4c	$124,000 00

PROPOSED METERS.

5,000—	1-inch—500 gals. per day,	912,500,000 gals.
5,000—	¾-inch—400 gals. per day,	730,000,000 gals.
12,000—	⅝-inch—300 gals. per day,	1,314,000,000 gals.
4,000—	½-inch—200 gals. per day,	292,000,000 gals.
3,200—	⅜-inch—100 gals. per day,	116,800,000 gals.
	3,365,300,000 gals. at 4c	$134,612 00
Total revenue from metered services		$501,387 00
Other revenue		6,613 00
Total estimated revenue		$508,000 00

"It should be borne in mind in considering this proposition that all of the estimates are founded on the number of consumers on record for 1911, no attempt having been made to include the normal increase which is sure to result. It must be recognized also that the change to a metered system will of necessity be a gradual one and will require at least four or five years for its complete development, during which time the revenue will be reduced by degrees only on account of the proposed change in rates, but will be increasing steadily by virtue of the normal growth of business.

"Summarizing the merits of the proposition, the following features appeal to both reason and a proper sense of justice: It furnishes water at the lowest rate consistent with the requirements of the plant; it makes the same rate to every one for the water consumed, while through the medium of the 'service charge' it gives the large consumer the advantage to which he is entitled by the practical absorption of this charge; it places the burden of the service charge exactly where it belongs, for the reason that it costs the same to be prepared to furnish water through a given sized meter to the consumer who uses but 200 gallons per day, as it does to the one who uses 2,000 gallons, while it does cost more to be prepared to furnish the quantity of water which would be normally consumed through a 6-inch meter, than would be the case with a ⅝-inch service, and, finally, it provides a system of rates based on the operating expenses, which can be readily adjusted to meet varying conditions without affecting its underlying principle."

Reduction in Putrescibility of Sewage by Settling and by Filtration.*

By Dr. Arthur Lederer, New York City.

WHEN we speak of a raw sewage being "strong" or "weak," we have, ordinarily, factors in mind which are furnished by the chemical determinations of total organic nitrogen, organic carbon, chlorine, and possibly fats. To one who is dealing continuously with one and the same sewage the suspended matter will give a fairly good idea of the strength of the sewage. It is likewise apparent that certain relations can be established between some of the chemical constituents from a long series of analyses. However, in different localities all these factors and relations will be subject to modifications, the chief cause for which lies in the varieties of trade wastes likely to be present in the majority of American sewages. In a general way a stronger domestic sewage will require more dilution in a water course than will a weaker, as expressed by any of these factors above.

Up to the time of the introduction of the methylene blue putrescibility test, we have lacked a definite expression for the strength of a sewage from the standpoint of a prospective nuisance. Since the vast majority of sewages reach the surface water in an unpurified or partially purified state, it is clear that any determination in which the natural agencies participate (as is the case in the putrescibility test of Spitta and Weldert) must of necessity come closer to the actual changes occurring in water courses than a purely chemical test, such as the determination of "oxygen consumed." This is the more apparent when we consider that the different methods in vogue of determining "oxygen consumed" give rise to very perceptible differences in the results. The methylene blue putrescibility test, as is well known, depends upon the formation of a colorless leucobase as the oxygen in the sample becomes exhausted. The test has been made more valuable by Phelps, who worked out relative stability figures which serve as a numerical measure of the relation between the available oxygen and the oxygen required for complete oxidization. Since the reaction is a biologic one, an incubation temperature of 20 degrees C. will favor the development of bacteria likely to take part in the self-purification of rivers, while a temperature of 38 degrees C. will favor the development of a bacterial flora not likely to take part in nature. The methylene blue test is at present almost universally used in sewage purification plants, and serves its purpose well. The main objection to the test, however, has been the time which is consumed to obtain results. This is the chief reason why sometimes an incuba-

*A paper before the American Public Health Association.

tion temperature of 38 degrees C. is preferred to the more desirable temperature of 30 degrees C.

Recently interest was awakened in the test for the loss of dissolved oxygen in a sewage mixture on incubation for a definite period of time under anaerobic conditions. The loss of oxygen, as determined quantitatively, serves as a measure of the stability of the sewage or the sewage mixture. This test is a more direct measure of the probable effect upon the stream than the methylene blue test. The test is not a new one. On looking over German literature repeated mention is found of "Sauerstoffzehrung" among the analytical data, the result of which is obtained by methods substantially the same as described above. Mention was first made of the results obtained with this method in this country in the report of the Lawrence experiment station for the year 1900 (Massachusetts State Board of Health). The test was also referred to recently as a good measure of stability by the writer, and by C. B. Hoover, of the Columbus Sewage Works. Hoover likewise recognized that the analytical results usually employed to show the degree of purification effected by sewage treatment do not reveal quantitatively the relative stability, and hence cannot be looked upon as reliable indices of the deoxygenating properties of sewages, sewage mixtures or effluents. As a result of a long series of tests he obtained certain definite relations for sewages, septic effluents and filter effluents as determined from a modified "oxygen consumed" test and the loss of dissolved oxygen on incubation, described previously. It may be possible to establish such a relation in dealing with one and the same sewage for a long time, but the relation is bound to differ in various places to a great extent. The method does not lend itself to a ready expression of the stability. Hoover measured his loss of dissolved oxygen by incubation at 37 degrees C. for 24 hours. There is a possibility, as Phelps has pointed out, in certain effluents, particularly those from rapid filters, of oxygen becoming lost at this temperature without being consumed. The saturation point of oxygen at 37 degrees C. is not over 7 p.p.m., and consequently there is a tendency for some of the dissolved oxygen to escape. Tight stoppers are not likely to prevent the escape of the released gas, nor are mercury seals adapted for routine work.

Recently Phelps introduced his method of calculating quantitatively the stability of a sewage mixture from determinations made by anaerobic incubation at 20 degrees C. for a given period of time. The sewages are mixed with water saturated with oxygen, and the total amount of oxygen is determined directly. The

TABLE I.

PARTS PER MILLION.

Serial No.	Solids in Crude Sewage.		Suspended Matter. After Four Hours Settling.			Oxygen Consumed.			Organic Nitrogen.			Per Cent. Permissible Sewage.		
			Original.											
	Total	Volatile	Total	Volatile	Total	Crude	Settled	Filtered	Crude	Settled	Filtered	Crude	Settled	Filtered
1	493	222	68	50	37	30	13.	5.5	46.	7.5	5.1	4.6	24.6	27.5	42.
2	629	313	266	124	91	55	29.	17.	11.	9.5	...	11.0	18.3	19.2	51.
3	594	295	118	84	45	43	30.	25.	20.	7.1	...	20.	4.2	5.0	11.1
4	630	335	162	119	52	40	37.	33.	23.	13.7	11.3	23.	2.6	5.5	9.4
5	680	385	194	126	75	55	52.	33.	26.	11.9	7.1	26.	5.0	7.3	11.8
6	654	344	227	127	67	44	51.	28.	23.	12.3	3.3	23.	4.7	10.3	21.3
7	592	322	187	120	65	57	52.	37.	29.	10.5	5.5	29.	3.0	5.4	13.3
8	642	318	206	107	65	50	45.	31.	21.	13.0	...	21.	10.1	18.3	29.4
9	547	270	76	52	51	44	27.	25.	24.	5.9	4.8	24.	17.7	19.1	29.8
Average	607	311	167	101	61	46	37.	26.	20.1	10.1	...	20.1	10.0	13.1	24.3

sample is then stored in a tight bottle for a suitable period of time and the oxygen redetermined. The rate at which the oxygen disappears under these conditions is a direct measure of the probable occurrence upon a stream. Under given assumptions, other than those actually occurring in a specific test, the following formula derived by Phelps may be used:

$$C = \frac{\log \frac{O^1}{O}}{Kt}$$

In this formula C represents the percentage of sewage permissible in the water used for dilution under the assumed conditions. O^1 is equivalent to the dissolved oxygen in the mixture before incubation expressed in parts per million, O the dissolved oxygen after incubation. K is a constant which defines mathematically the rapidity with which the oxygen is used up in a mixture of water and sewage. From a specific test K is determined. The formula can then be applied to other cases. According to Phelps K depends upon the character of the sewage matter and the concentration of that material in the sewage, and is independent of the extent of dilution or the character of the diluting water. Subsequent experiments made by the writer on crude sewages at the sewage testing station of the sanitary district of Chicago have proven, however, that the factor K is not independent of the amount of dilution. It represents in the formula the time which is allowed for the contact of water and sewage to produce the change in the oxygen of the mixture.

It occurred to the writer to utilize Phelps' quantitative expression of the stability of sewages to demonstrate the improvement of the liquid by the removal of the settling suspended matter and complete removal of all the suspended matter. The laboratory technique employed for these experiments was the same as employed by Phelps. Two dilutions were made as a rule on one and the same sewage. A dilution of one part of sewage to eight and ten parts of water from Lake Michigan has given satisfactory results. The time of incubation was 24 hours, and the temperature of incubation employed, 20 degrees C. The sewage was mixed with the lake water in a glass cylinder by a specially devised stirring apparatus, to insure the least possible aeration. A portion of the same sewage was also filtered through a single layer of Swedish filter paper, which removed all suspended matter and pseudo colloids. The same dilutions were made as with crude sewage and the initial dissolved oxygen determined just as in the crude sewage mixtures. The same dilutions were also made on another portion of the sewage after the suspended matter had been allowed to settle for four hours. Citrate of magnesia bottles, with patent stoppers, obtainable at any drug store, have proven very efficient for these incubation experiments. They do not permit air to enter, as do some of the bottles provided with ground stoppers.

All the results obtained were calculated on the basis of preserving 30 per cent. residual oxygen after a 24-hour period of contact or flow. Besides this test, other tests were carried on, such as total solids, oxygen consumed, and organic nitrogen, in order to bring out the relation of the volatile organic carbonaceous and nitrogenous matter in solution and suspension to the calculated permissible dilution. As mentioned previously, the factor K in Phelps' formula has not been found to be independent of the dilution. Special experiments carried on with three different dilutions on the same sewage have clearly shown that K will decrease with a lower dilution, and the factor C, of course, will be found to be correspondingly higher. It was further found that the difference in K between the lower dilutions is greater than the difference between the two higher dilutions. As yet the results have not demonstrated a constant difference between C (the percentage of sewage) resulting from the various dilutions, consequently an exponent has not been introduced in the original formula. The highest C value has been used to compare results. Values of one and the same dilution only are given for a comparison of the permissible percentage of crude, settled and filtered sewages in Table I. On the whole, the differences in the factor K in the different dilutions have not been materially different, and are hardly large enough to interfere with the intelligent interpretation of the results (Table I). The striking feature of this table is the last column, indicating the ratio of dilution or the "per cent. permissible sewage" (C) of the filtered sewage, as compared to the raw and settled sewage. The remarkable result is still more apparent in Table II, which indicates the improvement in percentages.

Looking over the average of the nine experiments in Table II, we note, for instance, that on removal of 63 per cent. of the total suspended matter, or 54 per cent. of the suspended volatile matter, the actual improvement in the sewage from the standpoint of a prospective nuisance is but 31 per cent. Results similar to this have been obtained by C. B. Hoover. The sewages with the low suspended matter (experiments 1 and 9) have the low percentage improvement. One exception is found in experiment 2, with a high suspended matter and a low improvement

from a dilution standpoint. Now, when we turn to the results obtained by filtration we will note in Table II that the removal of only 37 per cent. of suspended matter, or 46 per cent. volatile suspended matter additional to sedimentation has shown an improvement of 143 per cent. for dilution purposes, or nearly five times the improvement gained by merely settling the sewage. Similar is the case with the carbonaceous matter as expressed in "oxygen consumed." A reduction of 30 per cent. of "oxygen consumed" is equivalent to an improvement of 31 per cent. in dilution, while an additional removal of 16 per cent. in "oxygen consumed" gives an actual additional improvement of 112 per cent.

A thorough study of these two tables will clearly bring out the fact that the removal of suspended matter capable of settling in settling tanks constitutes an improvement from the dilution standpoint much less than the percentage of suspended matter removed. Since we have to consider the improvement of any sewage or effluent from the standpoint of the degree of dilution required rather than from the standpoint of the reduction of any chemical constituents (as shown by analysis), the improvement made by settling consists mainly in the improvement of the physical character of the liquid by the removal of material which may cause deposits, and incidentally some improvement in the stability. However, the removal of an additional small quantity of suspended matter not capable of settling, by simple filtration will improve the liquid far out of proportion to the percentage of volatile matter removed. This permits of only one conclusion: that is, on a domestic sewage from a large area the finely divided, slowly settling suspended matter and pseudo colloidal matter not capable of settling make up the greater part of the putrescibility, due to the suspended and colloidal matter. This fact has been recognized before. Spillner states that the organic sulphur compounds in sewages which afford the material for the development of hydrogen sulphide are found in much smaller quantity in the suspended matter capable of settling than in the dissolved colloidal and finely suspended matter which has been removed by filtration in these experiments.

In the present state of the science of sewage disposal we aim to destroy the finely suspended matters by oxidation. However, most of the sewage is discharged to-day either in a raw or settled state. If a device can be worked out to take care of the finely divided non-settling suspended matters without resorting to biologic treatment, a degree of purification may possibly be attained intermediate between settling and biological treatment, which in many cases may be sufficient to avoid the expense of the more thorough biological treatment.

In conclusion, the writer wishes to express his thanks to Prof. E. B. Phelps, of Boston, and to Mr. Langdon Pearse, engineer in charge of sewage disposal experiments in Chicago, for valuable suggestions, and, further, to Messrs. H. B. Hommon and F. Bachmann for their conscientious analytical work.

TABLE II.

Serial No.	Suspended Matter. Per Cent. Removed by Settling. Total.	Suspended Matter. Per Cent. Removed by Settling. Volatile.	Suspended Matter. Additional per Cent. Removed by Filtration. Total.	Suspended Matter. Additional per Cent. Removed by Filtration. Volatile.	Per Cent. of Volatile Matter Left in Solution After. Settling.	Per Cent. of Volatile Matter Left in Solution After. Filtration.	Per Cent. Reduction of Oxygen Consumed. Settling.	Per Cent. Reduction of Oxygen Consumed. Filtered.	Per Cent. Improvement in Permissible Sewage. Settling.	Per Cent. Improvement in Permissible Sewage. Filtered.
1	46	40	54	60	91	78	58	65	11	71
2	66	56	34	44	78	60	41	62	5	179
3	62	49	38	51	86	71	17	33	19	164
4	68	66	32	34	76	65	11	38	111	262
5	61	56	39	44	81	67	37	50	46	136
6	71	65	29	35	76	63	45	55	119	353
7	65	53	35	47	80	63	29	44	80	343
8	68	53	32	47	82	66	31	53	81	192
9	33	15	67	85	97	81	7	11	8	68
Average	63	54	37	46	82	68	30	46	31	143

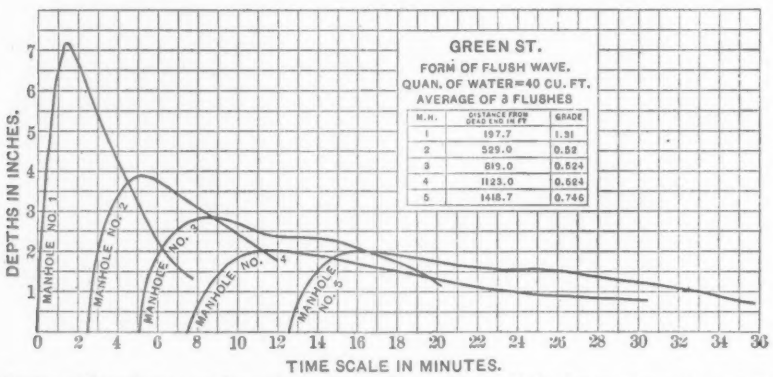
Methods and Results of Sewer Flushing.

THE use of additional water at the times of low natural flow to aid in carrying off those materials which are deposited in the bottom of the sewers, due either to the low velocity or flat gradient of the sewer, has been practiced for a number of years. Few sewerage systems at the present time are constructed without the use of some flushing device at dead ends, or at those points along the line of the sewer where it is found necessary to reinforce the scouring action of the natural flow of the sewage upon the carrier. The action of this flushing device might be compared to the use of a booster engine to assist heavily-loaded trains over a steep grade; the grade in this case, however, being either the flatness of the sewer line or the frictional retardation of the pipe or channel.

Textbooks have stated a number of fixed rules, whereby the need for flush tanks may be established. Some further data have been furnished by articles contributed to the engineering press. These latter have been in the nature of observations made upon flush tanks under actual service conditions, and have been described at various times. The data obtained have been along the lines of the velocity and effective length of the wave produced by the action of different volumes of flushing water discharged into sewers laid on various gradients.

Among the first data of this nature which were published were a series of diagrams prepared by S. H. Adams, a London engineer, and reviewed in MUNICIPAL ENGINEERING, vol. xiii, page 170. These diagrams gave the length of sewer on which observations were taken, the velocities in feet per second, the depth of the ordinary flow of the sewage, and the depth of water due to the flushing stream. In nearly every instance the observations were taken on a sufficient length of sewer to show a reduction in velocity to two feet a second, and in some cases to a greater distance. The effect of the flushing stream was stated to be valuable to distances varying from 1,300 to 2,500 feet with discharges of flushing water less than 500 gallons, and the distances increase to 3,500 feet for 12 to 18-inch sewers and 2,268 to 8,287 gallons discharge.

There is now under preparation a book on sewer flushing, prepared by Merritt & Co., Camden, N. J., which embodies a very clear explanation of the purpose of sewer flushing, some general data collected from various sources on the action of flushing water in sewers, as regards the amounts needed and the effective distance of its operation and its cost.


GREEN ST.
FORM OF FLUSH WAVE.
QUAN. OF WATER=40 CU. FT.
AVERAGE OF 3 FLUSHES
M.H. | DISTANCE FROM DEAD END IN FT | GRADE
1 | 197.7 | 1.31
2 | 529.0 | 0.52
3 | 819.0 | 0.524
4 | 1123.0 | 0.524
5 | 1418.7 | 0.746
DEPTHS IN INCHES.
MANHOLE NO. 1
MANHOLE NO. 2
MANHOLE NO. 3
MANHOLE NO. 4
MANHOLE NO. 5
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36
TIME SCALE IN MINUTES.
Results of Experiments on Green Street Sewer, Ithaca, N. Y. H. N. Ogden, Trans, A. S. C. E.

That portion of the book devoted to the amount of flushing water and the effectiveness of the flushing wave contains the results of experiments made in Ithaca, N. Y., and published in Transactions A. S. C. E., vol. xl, and the subsequent discussions. These experiments were made by H. N. Ogden, who in 1898 made inquiry among engineers of cities between 10,000 and 60,000 population, which had sanitary sewer systems, and presented the data obtained from his own experiments, together with the answers which he obtained in reply to his inquiries.

In reply to a question by Mr. Ogden regarding the relation between the minimum amount of water required for effective flushing and the grade of the sewer, there were only six answers received. Of these, two held that no difference should be made, three thought that less water

could be used on the steeper grades and one who had studied the matter in relation to sewerage systems under his care stated that one flush daily on a 2 per cent. grade was as effective as two flushes daily on a 0.5 per cent. grade, the quantity of flushing water in each case being 300 gallons.

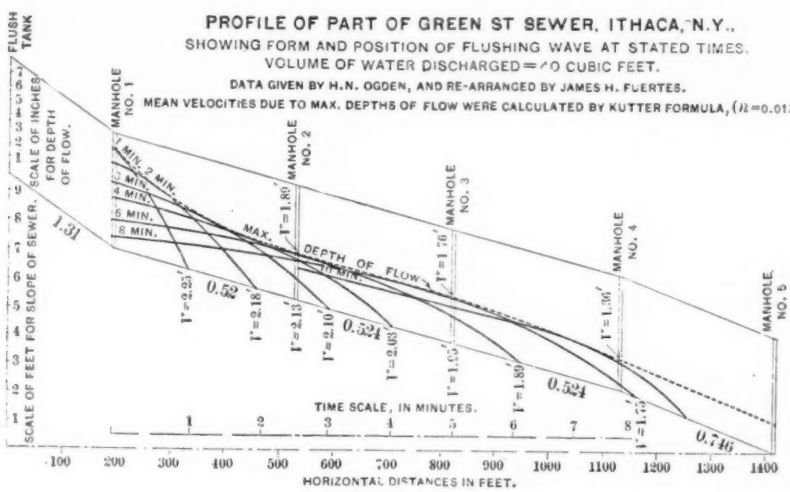
Mr. Ogden submitted a number of profiles showing the depths and computed velocities of the flush waves at varying distances from the point of admission of the flushing water, and also a graph showing the depth of the flush wave at various manholes where observations were made, with the time scale in minutes as the ordinate of the curves. These curves and profiles were further amplified by computations of J. H. Fuertes and Rudolph Hering.

In commenting on the Ithaca experiments, as described by Mr. Ogden, Mr. Hering says:

"The Ithaca data show how the velocity gradually decreases with the distance, and show the distances and depths of flow up to which the necessary cleansing velocity is maintained. They also show by figures how long such velocities continue. These velocities are not measured, but merely computed. They would, therefore, be somewhat different in practice, but how much is not yet known. As an example, when the flush wave is highest, a velocity of more than 2 feet per second is maintained for only one minute, and it extends less than 500 feet; when the water flows two-thirds this height, the velocity has continued for over fire minutes, and for this length of time it extends only about 400 feet; and when the water flows at one-third its greatest height, a velocity of over 2 feet per second has continued for about seven minutes, but for this length of time has extended only about 300 feet.

"This diagram clearly shows the well-known fact, that the greatest benefit from flushing is obtained by maintaining the cleansing velocity as long in time and as far in distance as possible. It is, therefore, desirable to determine for each case approximately the quantity of water needed to obtain a required and definite result in a sewer of a given size or slope, and the author's work materially facilitates this determination for the cases which he has covered."

Andrew Rosewater, formerly City Engineer of Omaha, Neb., made some experiments on 8 and 10-inch sewers, the results of which were given in MUNICIPAL ENGINEERING, volume xiv, p. 217. As shown by his observations, there is a marked acceleration in the velocity of


PROFILE OF PART OF GREEN ST SEWER, ITHACA, N.Y.,
SHOWING FORM AND POSITION OF FLUSHING WAVE AT STATED TIMES.
VOLUME OF WATER DISCHARGED = 40 CUBIC FEET.
DATA GIVEN BY H.N. OGDEN, AND RE-ARRANGED BY JAMES H. FUERTES.
MEAN VELOCITIES DUE TO MAX. DEPTHS OF FLOW WERE CALCULATED BY KUTTER FORMULA, (n=0.013.)
FLUSH TANK
SCALE OF INCHES FOR DEPTH OF FLOW.
SCALE OF FEET FOR SLOPE OF SEWER.
MANHOLE NO. 1
MANHOLE NO. 2
MANHOLE NO. 3
MANHOLE NO. 4
MANHOLE NO. 5
1.31
2 MIN.
3 MIN.
4 MIN.
6 MIN.
8 MIN.
MAX. DEPTH OF FLOW
1 MIN.
0.52
0.524
0.524
0.746
TIME SCALE, IN MINUTES.
HORIZONTAL DISTANCES IN FEET.

The following points are given in the Merritt book to summarize the data which they give:

(1) Except on steep grades, the flushing water discharged into the sewer runs

the flushing water in 8-inch sewers laid on a gradient greater than 1.4 per cent., and that in sewers laid on a less steep gradient, opportunity is given for the latter portion of the flushing charge to catch up with the first portion, so that the sewer is more nearly filled. This does not, however, mean that a flushing charge of less quantity is recommended for a sewer laid on a steeper gradient, for though in the case of the more flat sewer, the latter portion of the discharge will reinforce that which has gone before, yet a greater quantity will be required in the case of the flat sewer to give the necessary velocity to carry along the heavier particles in the sewage.

full bore for only a comparatively short distance, practically the entire flushing effect being secured by the normal gravity flow of the combined sewage and flushing water.

(2) The greater the grade of the sewer, the less the volume of water to procure effective flushing of a given length of sewer.

Comparison of Cincinnati Pavements.

THE Bureau of Municipal Research of Cincinnati has issued a report dealing with the selection of pavements. This report, which was prepared by James E. Barlow, engineer of the bureau, gives a careful analysis of the paving question in Cincinnati and outlines a system of cost records and historical data which will prove of great value in determining the kinds of pavement to be adopted in the future. The portion of the report which deals with the question of economy in paving construction presents an exceptionally thorough discussion of the method of comparing paving materials as regards their ultimate cost.

In the following abstract of this portion of the report it should be remembered that the actual figures of the comparison in prices are influenced by the proximity of Cincinnati to the center of the paving brick industry, which makes brick pavement lower in first cost, and also that the limestone which is found in that locality is comparatively soft and traffic conditions are such that a longer life for the macadam pavements might be observed under different conditions. The method of arriving at the comparative economies, however, warrants only favorable criticism.

The most economical pavement is taken to be that which will show the lowest average cost per year during its entire life. This annual cost is defined as that amount of money which, if applied annually, will keep the street under consideration perpetually paved and repaired; and is compared to an annual rental such as would be required should a public service company construct and maintain the pavement and charge such a rental for its use. In such an event, however, an additional charge for profit for the corporation would be charged.

The average annual cost is composed of three principal factors:

1. Average annual cost of repairs.
2. Interest on the cost of the pavement.
3. Annual charge on account of sinking fund; i. e., a fund set aside and invested each year such that the pavement, when worn out, will have been completely paid for.

In order to apply this principle to the selection of a pavement for a given street, certain exact data are necessary, such as the durability and cost of repairs of each kind of pavement under various conditions, especially those of traffic. As a matter of fact, the information of this character which is available in most cities is meager and fragmentary, due to the long period necessary for such an extended investigation and the lack of continuity of records through changing administrations.

To determine the annual interest charge, the first cost of the various kinds of pavements must of course be known. A study of public records shows that the price per square yard in Cincinnati for the past four years for the various kinds of pavements has been approximately as follows:

Kind of Pavement.	Min.	Max.	Approx. Average
Granite	$3.25	$4.69	$3.70
Wood block.....	2.60	3.93	3.45
Bitulithic	2.14	3.22	2.65
Asphalt	1.81	2.62	2.30
Brick	1.86	2.50	2.25
Granitoid	1.54	2.50	2.10
Macadam	.66	1.30	.95
Bowlder	1.50	2.15	1.75

The above prices include: (a) Excavation equal to the total thickness of the pavement; (b) all consolidation of subgrade; (c) a six-inch concrete foundation, and (d) furnishing and laying the surfacing complete above the foundation. The macadam is 12 inches thick and has no concrete foundation; the bowlder likewise has no concrete foundation. Inasmuch as a good Portland cement concrete foundation should outwear several surfacings, it will be necessary for the determination of the replacement fund to separate the cost of the foundation from that of the surfacing. One dollar per square yard may be taken as a reasonable average price, including work and materials, for the concrete foundation; subtract this figure from the amounts above given and the difference will represent the average cost of the surfacings. Upon these costs the interest is calculated, the rate assumed being 4 per cent.

The average cost of repairs for individual pavements during their life is

stated to be not available in Cincinnati. However, the gross amount of money expended annually for several years past on each kind of pavement is given. From this and such available records of the amount of each kind of pavement in use a figure is obtained for the average cost of local repairs per square yard per year, and summarized as follows:

Kind of Pavement.	Gross Expenditures for Repairs. 1908.	1909.	1910.	Average Cost Per sq. yd. Per Year
Asphalt	$ 62,994.00	$ 46,000.00	$ 48,271.44	$ .073
Granite	27,995.00	30,443.00	34,213.00	.026
Brick	14,005.00	22,797.00	10,016.00	.012
Bowlder	30,640.00	31,861.04	36,347.12	.033
Macadam	258,930.40	332,511.01	328,232.34	.076

The gross expenditures in the first three columns were taken from the annual reports of the street repair department. In order to determine the last column, the most recent United States Census Report was used as a basis for the amount of each kind of pavement in use. No allowance was made for streets under guarantee. Particular attention is called in the report to the high repair cost of macadam, espécially as compared with brick.

The annual cost of repairs to a Portland cement concrete foundation is assumed to be negligible.

In determining the annual payment on account of the sinking fund, the two factors noted were the initial cost and the durability or length of life. For the latter the figure desired for each kind of surfacing represents the average length of life under the average conditions to which it has been subjected in Cincinnati. The figures given below are of necessity not exact, but are fair approximations.

Granite	25 years
Wood block	?
Bitulithic	?
Asphalt	15 years
Brick	15 years
Bowlder	25 years
Macadam	8 years

The life of the Portland cement concrete foundation is assumed to be fifty years.

With the foregoing data as a basis, the annual amount of money required for the sinking fund is readily calculated by the use of standard tables.

The following table gives a summary of the foregoing data, on the basis of which is worked out the continuous annual expense per square yard for keeping paved and repaired each different kind of pavement under its actual local conditions:

Underlying Data—	Granite.	Wood Blk.	Bit.	Asphalt.	Brick.	Bowlder.	Macad.
First cost of surfacing	$2.70	$2.45	$1.65	$1.30	$1.25	$1.75	$0.95
Assumed life	25 yrs.	?	?	15 yrs.	15 yrs.	25 yrs.	8 yrs.
Average Annual Cost of Surfacing—							
Interest at 4 per cent on cost of surfacing	0.108	0.098	0.066	0.052	0.050	0.07	0.038
Average annual cost of repairs	0.026	?	?	0.073	0.012	0.033	0.076
Annual charge for sinking fund	0.063	?	?	0.063	0.060	0.041	0.100
Oiling or watering	.....	.....	.....	.....	.....	.....	0.04
Total, surfacing	0.197			0.188	0.122	.....	.....
Average Annual Cost of Foundation	0.046	0.046	0.046	0.046	0.046	.....	.....
Total average annual cost per sq. yd.	0.243	?	?	0.234	0.168	0.144	0.254

From the application of this annual expense method it is seen that the respective costs of granite, asphalt and macadam, under the actual conditions under which each has been used in Cincinnati, are not far apart, while brick is considerably lower. Bowlder is disregarded, being considered obsolete for general use. Lack of data on life and repairs makes figures for wood block and bitulithic uncertain, the latter having been first laid only about ten years ago.

Perhaps the most significant facts brought out by the above table are the relatively high cost of macadam and the relatively low cost of brick, the macadam costing nearly 50 per cent. in excess of brick. In comparing the above annual costs, the fact must not be lost sight of that the different classes of pavement are

not, on the average, subjected to the same traffic conditions; that is, macadam is used normally on streets of light traffic, and yet costs about the same as granite, which is used on the heaviest traffic streets. Hence, if the macadam were replaced with a more permanent pavement, its comparative costliness would be more marked than shown above.

The following table, which is taken from the last available report of the United States Bureau of the Census, gives a comparison of the various pavements in the principal cities of Ohio:

TOTAL PAVED AREA IN SQUARE YARDS—1907.

	Cincinnati.	Cleveland.	Toledo.	Columbus.
Stone Block	1,184,761	1,932,480	425,745	198,516
Wood Block	.....	19,888	128,563	.....
Brick	1,165,630	2,957,328	1,695,498	1,800,542
Asphalt or Asphalt Block	712,688	403,040	454,987	494,729
Bowlder	1,002,125	.....	45,090	50,450
Macadam	4,032,525	24,324	255,552	145,150
Bituminous Macadam	.....	13,728	34,933	2,151
Gravel	96,250	.....	.....	.....
All others	137,375	.....	.....	.....

The relative proportions of the several pavements used in each city are seen more readily from the following table:

PERCENTAGE OF EACH KIND OF PAVEMENT TO TOTAL PAVED AREA—1907.

	Cincinnati.	Cleveland.	Toledo.	Columbus.
Stone Block	14.2	36.4	14.0	7.4
Wood Block	....	0.4	4.2	....
Brick	14.0	55.1	55.8	67.0
Asphalt or Asphalt Block	8.6	7.5	15.0	18.4
Bowlder	12.0	....	1.5	1.8
Macadam	48.4	0.4	8.3	5.4
Bituminous Macadam	....	0.2	1.2	....
Gravel	1.1	....	....	....
All others	1.7	....	....	....

These area figures, it is stated, may not be strictly accurate, but they are the best records available. The table shows that Cincinnati has overwhelmingly favored macadam, one of the most expensive pavements, and has failed fully to utilize brick, one of the cheapest; while in the other cities the reverse is true.

In the larger cities of Ohio brick now constitutes from 80 per cent. to 90 per cent. of the total area paved annually, while in the smaller cities of the State it is practically the only pavement of a permanent nature used.

The local tendency in the use of pavements in the last few years is shown by the following tables:

PERCENTAGE OF EACH KIND OF PAVEMENT CONTRACTED FOR, 1908 TO AUGUST, 1911.

Granite	39.7 per cent.
Wood Block	24.7 per cent.
Bitulithic	3.2 per cent.
Asphalt	4 per cent.
Brick	14.5 per cent.
Granitoid	.... per cent.
Macadam	12.5 per cent.
Bowlder	1.4 per cent.

While recent paving work has included a smaller proportion of macadam than formerly, the use of expensive pavements is still observable. The statement is made that brick pavements should not be judged by most of those laid in Cincinnati, which are of poor quality.

EDITORIAL COMMENT

Engineering Publishing Company.—
Municipal Economy and Efficiency.

ENGINEERING PUBLISHING COMPANY.

It will be noted that this number of MUNICIPAL ENGINEERING is published by the Engineering Publishing Company. The change in publisher, while indicating a change in ownership, does not mean a complete change in management. The officers of the new company have all been connected for some time with the publication in the capacities of department heads, not having full authority in directing, of course, the policies of the publication. It is but fair to state that the officers of the new company now have full opportunity to put into execution plans that they have long cherished as department heads of the old company, which will make MUNICIPAL ENGINEERING a constantly improving source of authoritative information for its readers.

The magazine was started in 1890 under the title *Paving and Municipal Engineering*, by William Fortune, as a direct outgrowth of his work as secretary of the Indianapolis Commercial Club, with himself as editor, and William C. Bobbs, now the head of the Bobbs-Merrill Company, as business manager. The first three volumes, covering two and one-half years, were 9x12 inches in size and had a subscription price of $1.00 a year.

In January, 1893, the page was changed to the usual magazine size, the number of pages was largely increased, the subscription price was increased, and the title page first bore the name of Municipal Engineering Company as publisher. For nearly all of the time since that date, William Fortune has been the principal stockholder and manager of the business. Until 1901, he was also the editor. A department of "Letters for the People" was opened in the fourth volume, which was the forerunner of the present department, "From Workers in the Field." The "Question Department" was opened in July, 1895, with J. W. Howard, C. E., in charge, and was at first devoted to paving problems only. The present editor, Charles Carroll Brown, was put in charge of the department as regards other problems in July, 1896. Mr. Brown began "Editorial Comment" in August, 1896. Since 1901 he has been the editor-in-chief.

The development of the magazine has been no less rapid in the twentieth century than it was in the last decade of the nineteenth, and it has been necessary to increase the business department, first, by the addition of Russell Fortune, and then, of C. Stanley Sale, who have devoted themselves to the subscription and advertising departments, with ever-increasing duties in the management of the business, owing to the fact that the founder of the magazine has been drawn into other fields of work, which have demanded increasing attention from him.

The present time has seemed to be opportune for the transfer of the ownership of the property to those who are so intimately connected with its history, its progress, its purposes, its successes and its projects for the future. The result is that the Engineering Publishing Company has purchased the property of Municipal Engineering Company, and the magazine and the business connected with it will be conducted by a board of directors composed of Russell Fortune, as president; Charles Carroll Brown, as vice-president and treasurer, and C. Stanley Sale, as secretary and manager.

Although the past successes of the magazine have been marked and unusual in some respects, the new owners are confident of their ability to exceed those achievements. Both subscribers and advertisers will reap the benefit of the new enthusiasm which results from the greater responsibilities which they see before them.

Some of the improvements in contemplation will be ready for the new volume, which begins with the July number, and others will be announced in early numbers as they are finally developed through the careful consideration and discussion to which they are now subjected. The new organization takes this opportunity of expressing its appreciation of the good will and hearty support of the readers of MUNICIPAL ENGINEERING in the past, with full knowledge of the value of such support in promoting the growth of the publication, and to assure its patrons that its one great purpose is to make and publish the best and most reliable publication of its kind in the world.

MUNICIPAL ECONOMY AND EFFICIENCY.

The New York Bureau of Municipal Research, an organization supported by private funds, has been in operation about seven years. The Chicago Bureau of Public Efficiency, also supported by private subscriptions, was established with the aid of men trained by the New York Bureau. St. Louis has recently established such a bureau. Cincinnati, Philadelphia, Memphis and other cities have more or less permanent and efficient organizations of the same sort. Milwaukee is unique in having a Bureau of Economy and Efficiency, which has been supported by appropriations of various sorts made by the city government or by city departments. Prof. John R. Commons, one of its directors, has written a report of its first eighteen months' work, which is published in its Bulletin No. 19.

From all these efforts to increase the efficiency of our municipal governments one could, by careful study, make a fairly definite statement of the difficulties in the way, first, of showing clearly and without bias the existing inefficiencies and the reasons therefor; second, of securing full and consistent records of the operations of departments; third, of making plans for extracting the maximum of efficiency out of the departments; fourth, of securing laws modifying the organization of departments or of whole systems in case the maximum of efficiency cannot be attained under existing laws; fifth, of sustaining the bureau of efficiency permanently as perhaps the only method of keeping municipal officials up to the full performance of their duties, whether they have long or short tenure of office.

All of these difficulties are in the way of the utmost efficiency of the Bureau of Economy and Efficiency itself and some bureaus have failed entirely or are leading a more or less sedentary life as a consequence of finding one or more of these difficulties at least temporarily insurmountable. Thus one city finds it difficult to secure subscriptions enough to keep the bureau active, another finds its workers efficient in detail, but without the breadth of view necessary to produce the best results possible, another cannot find the expert guidance necessary, another finds a prejudice against criticism from outside sources which prevents the employment of experts from other cities and reduces the work of the bureau to a rather inefficient attention to minor matters, and the only bureau supported by city funds found it necessary to secure those funds in many different ways and to eke them out by all sorts of combinations with other organizations and with state officials and employes, that the expenditures might come within the meager funds available and at the same time secure valuable results. It will undoubtedly be difficult to maintain continuity under such conditions, especially in view of frequent changes in administrations and of the effect of political conditions upon the city council, which is the appropriating power.

Some of these difficulties are fairly well stated in Professor Commons's report, others are hinted and others remain to be inferred.

Thus far no bureau in any city has had time, force or opportunity to put into operation any complete system in any department. There are differences in character and efficiency of work, but the Milwaukee bureau may be considered as in some ways typical of those in operation, although it has the advantages and some of the disadvantages pertinent to its municipal support.

The first estimates of probable cost of the bureau were some $50,000 a year, but the work was started with an appropriation of $5,000, followed later by appropriations of about $10,500 for special use in the water and health departments, $18,000 for the general work of the bureau in 1911 and $12,000 for its work in 1912.

The water department appropriations were expended in making a survey of water waste and electrolysis, which will be of value in devising methods of preventing the 23 per cent. of waste which is estimated from the results of the study of a small section of the city; and in reorganizing the business department, under the advice and approval of the State Public Service Commission, and installing a system of water accounts which was one of the results of this reorganization. No definite estimate of the financial results of this work can be made until the work indicated to be necessary has been undertaken and carried forward for some time, but the saving to the city in cash can easily amount to tens of thousands of dollars a year, and the quality and efficiency of the service is already improved greatly.

The investigation of the refuse incinerator, an abstract of the report upon which has already been published in MUNICIPAL ENGINEERING, resulted in an improvement in the collection service and a saving of $10,000 a year, and the installation of some new machinery in the plant will increase materially the profits which may be derived from its operation.

The investigation of the bureau of sewers has resulted in a new system of operation by which better work is possible and the cost of operation can be definitely ascertained in such manner that economies can be instituted in the future. The lack of cost data in the past makes it difficult to make an estimate of the saving in this department. The same is true of the street sprinkling, flushing and oiling, sidewalk repair and street construction departments.

The new system in house drain and plumbing inspection has already shown a saving of $6,000 a year, and a consolidation of the construction and maintenance of the police and fire alarm telegraphs has saved $5,620 a year.

Seven other departments have been put under investigation and are developing improved systems of operation and record which will show similar savings if carried through.

Not all of the investigations have resulted in savings. The first intention seems to have been to improve the efficiency of a department by improving the service, and in nearly every case this has resulted in a decrease in expense or an increase in revenue as an accompaniment to the better service. In the health department, however, there has been a material increase in expense. The social survey of the city showed that many things were necessary to the sanitary welfare of the city which had heretofore been neglected. The work in prevention of tuberculosis, and in caring for children, in controlling contagious diseases, in sanitary inspections and abatement of nuisances requires much increase in force and expense, aggregating about $33,000.

The net result so far seems to be a promise of increased efficiency in all departments investigated and a net saving to the city which can be increased by further study and application of the same principles used in the work so far done.

The bureau recognizes its temporary character, there being no assurance, under the change of administration which has just taken place, that it will be continued when its appropriation for the current year is expended. The report therefore makes suggestions of methods of securing a measure of permanence in the work it is doing and of continuing it in the line of keeping the departments up to the standards of efficiency which have been set and of elevating them.

The idea underlying the suggestions made seems to be to keep the bureau as nearly independent of the municipal government as possible. Thus the Municipal Reference Department, which can do much in the way of investigation and comparison with other cities and in preparation and recommendation of ordinances and plans of operation, has been transferred to the public library control, its office in the city hall being operated as a branch library. This department can serve as the custodian of records and can publish the results in bulletins for general circulation.

Another suggestion is that one of the state bureaus, the Railroad or the State Tax Commission, take charge of the work. The Railroad Commission already has control over the accounting and some supervision over the operation of the water works as a public utility. If the city asks and pays the expenses the State Tax Commission can take similar charge of all the other city departments. Their supervision, under present laws, is limited to audit and inspection of work already done and does not include investigation and formulation of plans for improvement of methods.

The uncertainty regarding the action of city bureaus of efficiency is suggested by the statement that the New York Department of Commissioners of Accounts, which is responsible only to the mayor, was a handicap to civic progress until it was reorganized in 1909, since which time it has taken over much of the work of the private Bureau of Municipal Research. That it should be reorganized depended entirely upon the mayor, and that it was reorganized doubtless depended to a large extent upon the fact that the Bureau of Municipal Research was doing much work which the department should properly have done upon its own initiative or that of the mayor. There seems to be no safeguard against a relapse in case a future mayor does not desire to continue the work and the private bureau ceases its efforts to keep municipal officials up to proper standards of efficiency. The suggestion in the report that the Bureau of Economy and Efficiency be continued under the direct control of the mayor, presumably as to funds to pay its expenses as well as to work to be done, is coupled with the suggestion of a citizens' organization, supported by private subscriptions, to act as an independent critic of the bureau and of the departments which it is supposed to keep track of.

A brief reference to the City Service Commission which has been established recently points toward a possible combination which would be to some extent, and might be made almost wholly, independent of local political conditions.

The permanency of these movements is by no means assured as yet. Their real necessity is evident and the number of efficient workers is rapidly increasing. These are important factors, and the mass of data is increasing rapidly, so that something worth while will be evolved before long.

THE QUESTION DEPARTMENT

Indexes to Articles in Municipal Engineering.

The following lists of articles in MUNICIPAL ENGINEERING have appeared in vol. xlii:

Garbage and Refuse Collection and Disposal, p. 252.

Records in a City Engineer's Office, p. 253.

Water Purification in this number.

Construction and Operation of Septic Tanks and Other Sewage Disposal Plants, in this number.

Cost of Engineering and Fees for Municipal Engineering Service, in this number.

Cost of Construction and Operation of Sewage Disposal Plant.

I am interested in knowing the construction cost of a plant to treat 1,500,000 gallons of sewage per day. Would you please inform me through your columns the cost of construction of some works of that capacity, and what is the average annual cost of operating expenses per million gallons. Our sewage will not have to be pumped.

City Engineer, ———, Vt.

This question is not definite enough to receive a direct answer. If a simple sedimentation of the sewage is sufficient purification, the necessary tanks of the capacity named can be built for $1,500 to $3,000, according to local necessities and conditions as to excavation or embankment, thickness of walls, roof or building over tanks, etc. If septic tank action is sufficient the cost will be somewhat increased, according to system adopted, royalties to be paid, etc., and may easily be doubled or even more. If filtration is required, the first cost will be again doubled. Cost of operation increases still more rapidly, that of the sedimentation tank tank amounting to a few dollars for removal of sediment once or twice a year, and that of the last requiring much of one man's time with occasional assistance from laborers.

Some information can be derived from the following articles in recent volumes of MUNICIPAL ENGINEERING, those regarding the smaller cities being of direct interest in the study of the problem in the city from which the inquiry comes:

In vol. xlii: "Present European Practice in Sewage Purification," p. 9; "Chemicals in Septic Tanks," p. 39; "Tannery Wastes in Sewage, p. 78; "Information About Imhoff Tanks," p. 191; "Sewage Sludge Disposal," p. 227; "Residential Sewage Disposal Plants," p. 229; "Sewage Disposal and Pumping Plants," p. 307; "The Russell Sewage Disposal System," p. 347; "Governor Wilson Vetoes Bill Against Sewage Disposal Plant," p. 403.

In vol. xli: "Disposal of Sewage and Refuse," p. 289; "A Rotary Sieve for Sewage," p. 275; "Electrolytic Treatment of Sewage at Oklahoma City," p. 460; "Sewage Disposal with Respect to Offensive Odors," pp. 27, 116, 192; "Small Sewage Disposal Plant," p. 373; "Sewage Disposal in Bowling Green," p. 149; "Disposal of Single House Sewage, p. 42; "Disintegrator for Sewage Solids," p. 373; "Who Supplies Chloride of Lime for Sewage Treatment," p. 48; "Methylene Blue Sewage Tests," p. 373; "Electrolytic Sewage Treatment Plant at Santa Monica, Cal.," p. 229.

In vol. xl: "Patents on Septic Tank," p. 218; "Sewage Disposal and Pumping Plants," p. 264; "Modern Sewage Disposal," p. 181; "Sewage Disposal Plans of Atlanta, Ga.," p. 1; "Sewage Disposal with Respect to Offensive Odors," p. 395; "Sewage Plant at LaGrange, Ill.," p. 226; "Centrifugal Machine for the Drying of Sewage Sludge," p. 62; "Purification of Brewery Refuse," p. 433; Review of Maxwell and Brown's "Encyclopedia of Municipal and Sanitary Engineering," p. 365; "The Electrolytic Sewage Treatment Plant at Santa Monica, Cal," p. 229.

In vol. xxxix: "Sewage Purification by Irrigation," p. 38; "Covers for Septic Tanks," p. 39; "Effect of Sewage and Sewage Gases on Portland Cement Concrete," p. 41; "Wish to Utilize Denver Sewage," p. 54; "Purification of Dye Water," p. 88; "Use of Sewage for Irrigation at Fresno, Cal.," p. 117; Review of Raynes's "Domestic Sanitary Engineering and Plumbing," p. 148; Review of Moore and Silcock's "Sanitary Engineering," p. 229; "Cameron Septic Tank Patents," p. 238; "Books on Sewage and Sewage Disposal," pp. 291, 391; "Treatment of Brewery Wastes," p. 292; "The Present Use of the Septic Tank," p. 349; "Books and Patents on the Septic Tank," p. 390; "Eastern Installation of Septic Tanks and Contact Beds," p. 470; "Prevention of Odor From Septic Tank Effluent," p. 470.

In vol. xxxviii: "Cost of Septic Tank," p. 40; "The Character of Stream Pollution as Affecting by Purification Plant Design," p. 99; "New British Sewage Disposal Works," p. 177; "Information About Cameron Patents on Sewage Purification Processes," p. 192; "Sewage Purification for the City of Dres-

den, Germany," p. 248; "Sewage Purification and Stream Pollution in Ohio," p. 275; "Sewage Purification for New York City," p. 276; "Information About Sewage Disposal," p. 346; "Effect of Sewage and Sewage Gases on Concrete," p. 390.

In vol. xxxvii: "The Sludge Disposal Problem in Sewage Purification," p. 19; "Methods of Disposing of Sewage Sludge," p. 40; "Status of Sewage Disposal in America," p. 80; "Agriculture on a Sewage Filter," p. 105; "Effect of Sewage Pollution on Stream, Cost of Disposal Plant," p. 106; "Sewage Disposal Plants and Stream Pollution," p. 119; "The Cesspool and Its Dangers," p. 240; "Information About the Septic Tank," p. 253; "Books on Sewage Disposal," p. 253; "Report on Sewage Disposal for Trenton, N. J.," p. 267; Review of Dunbar's "Principles of Sewage Treatment," p. 269; Review of Gerhard's "Sanitation of Public Buildings," p. 270; Review of Scoble's "Land Treatment of Sewage," p. 270; Review of Starbuck's "Modern Plumbing Illustrated," p. 340; "Disinfection of Sewage and Sewage Effluents," p. 365; "Sewage Purification in Washington," p. 410.

In vol. xxxvi: "Information About Septic Tanks and Well Boring," p. 110; Review of Venable's "Methods and Devices for Bacterial Treatment of Sewage," p. 123; "Sewage Purification by Sedimentation," p. 173; "Best Method of Purifying Sewage," p. 238; "Information About Septic Tanks and Sedimentation of Sewage," p. 241; "Patents on Septic Tanks," p. 243; "Condemnation of Public Property for Sewage Disposal Plant," p. 252; "Growth of the Sewage Disposal Idea," p. 290; "Proposed Sewage Purification Process in Orange, N. J.," p. 325; "Methods of Sewage Disposal," p. 362.

In vol. xxxv: "Electric Purification of Sewage," p. 40; Review of Merriman's "Elements of Sanitary Engineering," p. 48; "House Sewage Disposal," p. 116; "Sewage Disposal in Columbus, O.," p. 211; "Methods of Sewage Disposal," p. 240; "State Control of Sewage Disposal," p. 242; "How to Build Residential Sewage Disposal Plant," p. 244; "Books on Sewage Disposal," p. 245; "Septic Tank Patents," p. 288; "The Septic Tank Patent Litigation," p. 311; "Residential Septic Tanks," p. 316; "Purification of Chicago's Sewage Recomended," p. 324; Review of Barwise's "The Purification of Sewage," p. 325.

In vol. xxxiv: "Septic Tank for Creamery Waste," p. 30; "Regulation of Stream Pollution and Water Purification," p. 92; "Septic Tank Patents Sustained," p. 94; "State Control of Sewerage and Water Supply in Pennsylvania," p. 106; "Patents on Sewage Purification Process Sustained," p. 107; Review of Vernon-Harcourt's "Sanitary Engineering with Respect to Water Supply and Sewage Disposal," p. 108; "The Law Regarding the Pollution of Streams," p. 228; "Residential Septic Tanks," p. 230; "Storage Time of Sewage in Septic Tank," p. 236; "Efficiency of Sewage Disposal Plants in New York City," p. 242; "State and National Control of Stream Pollution," p. 243; "The Septic Tank Patent Question," p. 303; "A Strong Sanitary Law," p. 354.

In vol. xxxiii: "State Sewerage Board Advocated for Ohio," p. 44; "Effect of Chicago Sewage on Mississippi River," p. 44; "Some Relations of Stream Pollution and Water Purification," pp, 151, 231; "Sewage Disposal by Biological Process," p. 173; "Books for Engineers," p. 175; "Books on Sewage Disposal," p. 249; "Sewage Disposal for Rural Residences and Villages," p. 249; "Books on Septic Tank," "Sewer Cleaning Machinery," p. 249; "New Jersey Municipalities Move Slowly in Matter of Stream Pollution," p. 261; "For and Against Chicago Drainage Board Plans," p. 262; "Rochester Proposes to Discharge Sewage Into Lake Ontario," p. 262; "Progress in Sewage Disposal," p. 312; "Sewage Disposal Plant at Kew Beach, Toronto, Ont.," p. 315; "Septic Tank Construction," p. 339; "Sewage Disposal for Institutions and Small Communities," p. 379.

In vol. xxxii: "Septic Tank for Chautauqua Grounds," p. 17; "Explosion of Saratoga Septic Tank," p. 42; "Cities Using Septic Tanks," p. 95; "Mt. Vernon, N. Y., Must Install Sewage Purification Plant," p. 193; "The Septic Tank Suit," p. 268; "Small Septic Tank and Filter," p. 395.

In vol. xxxi: "Disposal of Creamery Waste," p. 20; "Septic Treatment of Sewage," p. 20; "Sewage Purification Recommended for Baltimore," p. 47; "The Sewage Disposal Plant at Downers Grove, Ill.," p. 48; "The Origin of the Septic Tank," p. 178; "Disposal of Dye and Wool Finishing Waste," p. 204; "Report on Sewage Disposal for Paterson, N. J.," p. 211; "The Sewerage of Baltimore," p. 260; "Articles on Septic Tanks and Sewage Filters," with long list of previous articles, p. 280; "Sewage Disposal," p. 439; "Advance in Sewage Purification," p. 439; "Legislation Regarding Stream Pollution," p. 444; "Report on Sewage Disposal for Toronto," p. 454; "Books on Design of Septic Tanks," p. 454.

In vol. xxx: "The Tankage of Sewage," p. 36;; "Information About Septic Tank," p. 206; "Septic Tanks for Regina, Canada," p. 214; "Sewage and Dye Waste Disposal," p. 276; "Sewage Disposal in Septic Tanks," p. 350; Review of Baker's "Sewerage and Sewage Purification," p. 378.

The books mentioned in the above list as having been reviewed are the latest on the subject and nearly all of the valuable books are included in the list.

Who Can Prevent Pollution of Ohio River By City Sewage?

The city of Henderson, Ky., is considering the adoption of some plan for a system of sewers; but, while the town lies on the Ohio river, its topography is such that it is impracticable to carry the sewage directly

into the river by gravity, without a prohibitive expense.

This being the case, the common council has been considering the alternative of pumping the sewage into the river, or else putting in some system of treatment and discharging it into a creek where most of it is now discharged.

In this connection, I wish to ask you a few questions.

What legislation has been adopted, or is being contemplated, if any, by the state of Indiana in regard to the discharge of sewage into the Ohio river?

What legislation, if any, has been adopted, or is being contemplated, by the states of Ohio and Illinois in regard to the discharge of sewage into that river?

If no such legislation has been adopted, or is being contemplated, by any of the states named, what time will elapse, in your judgment, before some such legislation is adopted?

R. W. BALL, City Engineer,
Henderson, Ky.

The states of Ohio and Indiana have made careful determinations of the pollution of the Ohio river by their own cities, and, with Illinois, have been considering the question of limiting this pollution. No state can pass a law which will be binding on any other state, and joint action of all the states interested has been assumed to be necessary before the pollution of the Ohio can be completely regulated. The states opposite Kentucky are in a peculiar situation, because the boundary of the state of Kentucky is at low water on the north side of the river and the states of Ohio, Indiana and Illinois front on the river, but have no rights of control in it below low water mark.

Careful search has revealed no way in which the states on the north side of the river can exercise any control over pollution of the river outside their own boundaries. The possibility that Kentucky could control the pollution of the river by the other states mentioned, on account of its jurisdiction over the whole of the stream at low water, does not seem to have arisen as yet. Perhaps Kentucky holds the key to the situation.

Leaky Sewer Joints.

A sewer system has been recently finished at this place and no house conections made therewith. From the outfall there is pouring a quantity of ground water. The 10-inch pipe was running about half full after a recent rainy season. During the construction of this system the joints were not packed with oakum but only cemented. Is this defect sufficient to cause much trouble? Should not the joints have been calked up sufficiently well to have kept out almost all of the ground water?

M., ———, S. C.

If the outlet pipe was not designed to carry a proportion of leakage, the amount reported would be objectionable ultimately, if not at present. It is quite common in a separate sewer for house sewage only, to make an allowance for ground water or other water from outside sources.

Really this is a matter of relative expense of construction. In ordinary ground, where there is little danger of leakage into the sewer, there being little or no ground water, a slight increase in size of pipe, or in estimate of depth of flow in the pipe, will make little or no difference in the cost of the sewer, and will keep the design within safe and economical limits. It will be true, also, that at the beginning the amount of sewage will be small, and the amount of leakage will be maximum, and the leakage will diminish from the gradual closing up of such small seepages of water through porous cement joints by the deposit of fine material from the surrounding earth. Thus the leakage will diminish as the amount of sewage increases and the sewer will probably not be overcharged at any time.

If the sewer is laid in ground which is permanently wet or in gravel or porous soil subject to great variations in amount of ground water, either the allowance for ground water must be large and permanent, thus increasing the size and cost of the sewer or special means must be used to make the sewer joints water tight. If the sewer discharges into a stream unpurified, estimates of the increase in cost of the sewer on account of the use of larger pipe and on account of making the joints water tight may be compared and the cheaper method may be chosen. If the sewage must be purified before discharge, the cost of purifying the sewage alone should be compared with the cost of purifying the larger quantity of sewage diluted with the ground water leakage and the capitalization of this difference in cost applied. This will probably show an increase in the cost of disposal of the diluted sewage over the undiluted and may turn the scale in favor of making the joints water tight and thus keeping the size of the pipes down to their capacity for house sewage only.

The decision, especially if the sewage is not to be purified, may be modified by the character of the material in which the pipes are laid. If this is coarse gravel with ground water supplied from an ample source, the joints will not have much opportunity to silt up and the leakage will continue indefinitely. In other cases the leakage will diminish more or less rapidly toward a minimum which may or may not become zero.

Information on all the points covered must be given before a decision can be made as to the effect of the leakage, and there must be further information regarding the terms of the contract before responsibility for objectionable leakage can be placed.

Information about methods of making water-tight joints can be obtained from practically every volume of MUNICIPAL ENGINEERING and from the makers of materials therefor listed in the "Business Directory" published in each number of MUNICIPAL ENGINEERING under the headings "Jointite," "Sewer Joint Compound."

Where to Get Molds for Concrete Pipe.

I am a member of council. Our borough wishes to convey underground a small creek or running stream of water that now flows

in an open flume or ditch. The size of pipe required would be 36 or 48 inches. I myself am much interested in the project, and since we do not have the benefit of any municipal engineer, and myself having been connected with concrete construction, the town council looks upon me to formulate a plan whereby this project might be carried out.

The amount of pipe required would be about 500 feet, yet our funds available would permit us to lay only a small part each year until completed, as we could not raise any money by bond issue, since we already are bonded to the limit. I consequently think it would be better for us to purchase our own concrete pipe molds and make and place such pipe as our finances would permit each year until same was completed.

I wish to know where such molds can be purchased. I know of several concerns which control large reinforced concrete pipe molds, but do not sell molds, but contract pipe made on the job. This, you will see, would not fit our case, as we would not be financially able to handle any large part at one time, but, having molds, we could make and place as our means warrant.

M., ———, Pa.

The pipe line can be of reinforced or of plain concrete. In the former case the pipes can be made in lengths outside the trench and laid after they are cured. This could hardly be done with plain concrete with pipes of the sizes named. In either case the pipe could be made in place in the trench, over forms, provided the flowing water could be kept away from the concrete until it was fully set. The drain can also be made of concrete blocks made in molds and set over forms, using cement mortar for making joints. Reinforcement can be used with the blocks, if desired. In any case it is advisable to employ an engineer to make a plan for the work, deciding which method will be best under the circumstances, fixing the size of drain, the details of construction, etc. There is considerable difference in the cost of 36 and 48-inch drain, and an engineer may easily save his fee by his recommendations based on accurate knowledge. Names of competent engineers in the vicinity of the borough will be found in the "Business Directory" published in each number of MUNICIPAL ENGINEERING, under the headings, "Civil Engineers," "Consulting Engineers." Makers of molds for pipe lengths, for monolithic, plain or reinforced concrete drains and sewers, and for blocks will be found under the headings, "Concrete Block Machines," "Concrete Shaping Tools," "Conduits," "Contractors' Tools and Machinery," "Culvert Pipe," three headings, "Drain Tile," "Hollow Building Blocks," "Sewer Machines," "Sewer Pipe," "Sewer Pipe Molds," "Trench Machinery," "Water Tank Molds."

Remedy for Scaling of Concrete Curb.

We have had some trouble here with our concrete curb. The plaster is cracking and in some places has fallen off. There seems to be no bond between the plaster and the concrete. Do you know of any way to replaster the old curb with a wearing course that would stick? The curb was put in last summer. P., Borough Engineer,

———, Pa.

What can our readers recommend? The difficulty seems to be one of construction, such that the contractor, if the work was done by contract, should be held responsible and should be required to replace the curb entirely. There is no reason why a competent contractor should not be able to construct the curb so that there is complete bond of the body of the curb with the outer facing. If there has been failure to make this bond, it is almost or quite as cheap to tear the curb out and start new as to attempt to put a plaster on the outside of the curb and make it stick.

The use of the word "plaster" in the question in connection with the outer surface is an indication of a wrong idea regarding this outer surface. It is by no means a plaster, and should never be treated or applied as such, but it must be made an integral part of the curb, although it may be somewhat richer in cement than the body of the curb.

Street Cleaning, Garbage and Refuse Collection and Disposal.

Our city council is contemplating garbage disposal and would like names of firms or companies handling or manufacturing apparatus for street cleaning, transfer and disposal of refuse and garbage.

P., City Engineer, ———, Kans.

Names of such persons will be found in the "Business Directory" published in each number of MUNICIPAL ENGINEERING, under the headings Dump Cars, Dump Carts, Dump Wagons, Garbage Disposal Plants, Incinerators, Refuse Destructors, Sweepers.

Private Collection and Disposal of Waste and Disinfection of Premises.

I wish to get some information through advertisements or otherwise concerning the modern methods of disposing of waste paper, rags, and such dry refuse as accumulates around offices and residences.

It appears that a systematic cleaning and disinfection of private premises by a concern organized for the purpose and prepared to do such work scientifically might form a basis for profitable business in spite of city health department. If you can refer me to a source of information along this line I will appreciate it. J. M. H., Waco, Tex.

In the list of articles on garbage and refuse collection given on p. 252 of the April number of MUNICIPAL ENGINEERING will be found a number of articles of direct application to such a case as that mentioned, so far as collection and disposal of the waste is concerned. If there can be complete separation of the household waste, so that the dry refuse mentioned can be collected without contamination by decomposing liquids or wet solids, there will probably be some profit over the cost of collection, sorting, selling and destruction of unsalable refuse.

Whether the private cleaning and disinfection of premises would be profitable would depend upon the local conditions. Ordinarily it is difficult enough to enforce the public performance of such duties without cost to the citizen, and collection of any assessment

of cost can be made only by force of strong laws rigidly enforced. The town whose citizens would voluntarily pay such expense is indeed fortunate in the high quality of its citizenship.

Articles on Water Purification.

Would be pleased to have references to articles showing the advantages of mechanical filtration plants.

R. P. C., Columbus, Ind.

The best way to judge of the relative value of the various methods of filtration is to compare the operation of plants constructed according to their principles. The following articles in recent numbers of MUNICIPAL ENGINEERING give the descriptions of plants and other information and discussion of principles and practice. The books referred to are also excellent sources of information.

In vol. xlii: "The Chloride Process for Water Purification," p. 159; "Water Supplies, 1911-1912," p. 312; "The Value of Pure Water," p. 374; "The Cost of Water Filtration," p. 408; "Municipal Water Plant at McKeesport, Pa.," p. 410.

In vol. xli: "Municipal Water Purification Plant, Grand Rapids, Mich.," (rapid mechanical) p. 429; "The Water Filtration Plant at Toronto, Ont.," p. 445.

In vol. xl: "Chemical Clarification of Water," pp. 217, 433; "A New Reisert Water Filtration Plant," (rapid) p. 305.

In vol. xxxix: "A Machine for Washing Filter Sand," p. 66; "Water Purification by Ozone," p. 103; "Machinery for Ozonizing Water," p. 115; "The Sterilization of Water," p. 222; "Mechanical and Slow Sand Filtration of Water," making some comparison of the two systems bearing these names, p. 289; "Cities Using Hypochlorite in Water Purification," p. 387; "Chattanooga Water Works Report," p. 396.

In vol. xxxviii: Reviews of annual reports of Reading, Pa., and New Orleans, La., water departments, p. 56; "Proposed Improvements of Water Supply of Washington, D. C.," p. 57; "The Character of Stream Pollution as Affecting Purification Plant Design," p. 99; "Filtering Intake for Water Supply From River," pp. 112, 197; "Water Supply and Treatment for Power Plant Purposes," p. 160; "Cost of Filter and Standpipe," p. 264; "Experience With and Results From Municipal Water Softening," p. 383.

In vol. xxxvii: "The Sterilization Plant of the Jersey City Water Supply Company," p. 6; "A Biological Process of Clarifying Water," p. 23; Report of Convention of Am. Water Works Association, p. 53; "Plant and Process of Sterilization of Boonton Reservoir Water, Jersey City Water Supply," p. 86; "Water Softening or Purification and Its Saving," p. 92; "Water Sterilization at Boonton, N. J.," p. 158; "The New Water Filtration Plant for Toledo, O.," (rapid mechanical) p. 245; "Water Works, Water Supply and Filtration," p. 257; "Valuable Data Regarding Water Supplies," pp. 258, 330, which notes mechanical filtration at Birmingham, Ala., Macon, Ga., Anderson, Ind., Muncie, Ind., Bangor, Me., Binghamton, N. Y., Charlotte, N. C., Wilmington, N. C., McKeesport, Pa., Columbia, S. C., Norfolk, Va., and Petersburg, Va, slow sand filtration at Indianapolis, Ind., and Superior, Wis., infiltration wells or galleries at Springfield, Ill., and Ft. Wayne, Ind.; "Concrete in Water Works Construction," p. 387; "The Water Supply of McKeesport, Pa., p. 402.

In vol. xxxvi: Review of Turneaure and Russell's "Public Water Supplies," p. 52; "Information About Water Filtration," giving a list of earlier articles and books on the subject, p. 108; "The Water Filtration Plant at Ashtabula, O.," (rapid) p. 284; "Information About Sand and Mechanical Filters for Water," a list of previous articles, p. 315; "New Jersey Cities Can Erect Water Purifying Plants," p. 325.

In vol. xxxv: "Pennsylvania Water Companies Must Furnish Pure Water," p. 46; "The Collection of Water by Galleries at the Richmond, Ind., Water Works," p. 86; "The Public and Private Water Supplies of Indianapolis," p. 167; "Water Filtration and Meters in Washington," p. 190; "Method of Using Copper Sulphate in Reservoir," p. 249; "Cost of Operating Sand Filters," p. 252; Review of report of Reading, Pa., Water Commission, p. 258; Review of report of city engineer of Providence, R. I., p. 260; Review of report of Dover, N. H., water commissioner, p. 326; "Importance of the Proper Operation of Water Purification Plants," p. 352; "Litigation Over Patents on Negative Head Apparatus in Water Filtration Plants," p. 393.

In vol. xxxiv: Review of report of city engineer of Providence, R. I., p. 43; Review of Christie's "Boiler Waters, Scale, Corrosion, Foaming," p. 111; "The Collapse of the Lawrence, Mass., Filter Roof During Construction," p. 138; "Purification of Water Supply at Lawrence, Mass.," p. 209; "The Removal of High Turbidity from Water Without the Use of Coaguiants," p. 240; "Pollution of Mohawk River is Serious," p. 242; "The Copenhagen Water Supply," p. 349; "Aeration of Water Supply," p. 364.

In vol. xxxiii: "Success of Washington Filtration Plant," p. 46; "Books for Engineers," pp. 96, 175; "Results of Filtration Experiments and Water Waste in Washington," p. 112; "Progress on Philadelphia Filtration Plant," p. 114; "Some Relations of Stream Pollution and Water Purification," pp. 151, 231; "The Water Filtration Plant of Harrisburg, Pa.," p. 155; "The Water Purification Plant of Harrisburg, Pa.," p. 221.

In vol. xxxii: "Proposed Improvements in Brooklyn's Water Supply," p. 99; "Decision on Philadelphia Filtration Contract Suits," p. 184; "Necessity for Filtration of Water Supplies," p. 400.

In vol. xxxi: "Work on Toledo Filter Conduit to Proceed," p. 29; "A New Slow

Sand Filter for Lawrence, Mass.," p. 92; "Needs of Washington's Water Supply System," p. 228; "On the Prevention of the Growth of Algae in Water Supplies," p. 291; "Books on Filtration and Analysis of Water," p. 397; "The New Orleans Water Works," (rapid sand filtration) p. 428; "Copper Sulphate Results," p. 467.

In vol. xxx: "Toledo's Water Purification Contract Enjoined," p. 300; "Filter for Small Reservoir," p. 349.

Indexes for Water Consumers' Accounts.

Please state what is the usual manner and what do you recommend for indexing accounts for reference from your rated water register? For instance, a consumer will come in and give his name and street number, but does not know his service number. How will you quickly locate him on the register? J. C. C., ——, Wash.

The card system of applications for water service should be used as a part of the water record system. The application card is in two parts, one part containing the "application" made by the customer for service, stating what connections are wanted, rates, etc. The other part is called the "connection card," and contains the instructions as to fixtures to be used, and on the back a sketch and blank for plumber's return of work done. The "application card" is filed under the street name and number when the application is made. The "connection card" is separated and given to the customer or his plumber, and is filled out and returned to the water office. After inspection is reported by the company's inspector this card is filed under the name of the customer. Each card has spaces in which are filled the register number, the application number and the page of the water register on which the account is entered. There are thus two card indexes of every service, by location and by customer's name, and there may be a further application register if desired, in which each application is entered and given its number, thus making it possible to find any account by any one piece of information about it.

Best Material for Village Streets.

This city will purchase some sort of material for use on the streets this summer. Heretofore crushed stone has been used, but last summer a few blocks were covered with novaculite as an experiment. This material has proven very satisfactory on level stretches of the streets, but this city is located on hills, there being more or less grades on each and every street, and the novaculite fails to stick as desired. Some new material which will stick on hills and will make a good even and hard street will be wanted. What can you recommend, and what have your advertisers?

City Clerk, ————, Ill.

Treatment of the existing roads with such reconstruction as may be found necessary in some places, using road asphalts as a material to hold the broken stone or novaculite in place may be recommended. The names of makers of this material will be found in the "Business Directory" published in each number of MUNICIPAL ENGINEERING, under the heading "Asphalt." Tar may be used in the same way, which can be purchased of firms named under "Concrete Tar," "Pitch," "Road Tar," "Tar and Pitch," "Tar, Road," "Tarvia." Perhaps some of the materials may serve the purpose, which are made by those listed under the headings "Dust Laying Compound," "Macadamizing," "Mineral Rubber," "Road Binder," "Road Oils."

If more durable pavements are desired there are several excellent pavements for the uses named, which are comparatively low in cost, made by some of the firms listed under "Paving Materials." Reference may be made also to the lists under "Granocrete Pavement," "Paving Brick," "Stone Pavements," "Wire-Cut Lug Bricks," if the funds available will cover the cost of such improvements.

Ashes for Macadam Binder.

I have been told that common coal ashes has been extensively and successfully used in Scotland as binder for macadam. Can you tell me whether this is correct, and whether it has been used in this country, and whether or not it is as good as stone screenings for water-bound macadam? Any information along this line will be very much appreciated. E. W., ———, Mich.

The writer knows of no such use of ashes. The use could be but local, as the amount of ashes produced, except in a large city, bears but a small proportion to the amount of binder necessary in the roads of the locality. Doubtless the fine ashes would serve the same purpose as stone dust or other fine material, but there are large proportions of cinders in ordinary ashes, which break up and are unstable and difficult to handle. There is also quite a large proportion of unburnt coal, which can serve no very good purpose in a road, besides being difficult to compact into the voids in the stone. It is generally considered that nothing is quite so permanent as a binder as clean sand and clean screenings of the stone used in making the road, and anything else is but an approximation in quality. When the material is as irregular in nature and condition as ordinary coal ashes the presumption is against success, or at least against permanent success.

Can our readers report any facts in response to this inquiry?

Cost of City Engineering and Fees for Municipal Engineering Services.

In the February number of your magazine I saw an article bearing on percentage of cost of engineering in small cities, which showed that the cost varied in accordance with the amount of work done. I should be glad to know if you have any further data published in any back numbers on the same subject. CITY ENGINEER, ———, N. J.

The article referred to gives a suggested system of charges for municipal engineering

services when the city or town does not employ a city engineer on regular salary. There are several articles in other numbers of MUNICIPAL ENGINEERING giving information on this subject and others giving data as to the actual percentage cost of doing the city's engineering work, computed from the expenditures on public work and the total cost of the city engineer's office. These data are not always directly comparable, for in some cases the city pays the cost of inspection and it is included in the cost of the city engineer's office; in others the inspection is taken care of in another department and is not included in the city engineer's report, and in still others it is charged to the contractor or directly to the property owners, in which cases it may or may not, probably does not, appear in the city engineer's report.

In the current volume are the article referred to above, on p. 115, which applies the schedules of fees laid down in earlier articles to municipal work, and one on p. 258, giving a detailed schedule of charges which can be applied directly to any particular case, and a preliminary estimate of the total cost of engineering services can be made if the estimated cost of the improvement is made. This schedule will give nearly the same resulting charges as are given in that on p. 115. The schedule of California consulting engineers is given in this number.

In vol. xli, pp. 290 and 360, are articles giving cost of engineering on good roads, which may be of interest in this connection.

In vol. xxxix, p. 37, is an article on "Charges for Engineering Services Computed on Total Cost," and on p. 203 is one on "Charges for Engineering Services," giving the essential figures in a schedule printed in detail in vol. xiii, p. 197.

In vol. xxxviii, p. 76, is an article on "Relative Cost of Municipal Work Done by Day Labor and by Contract," which may throw some light on the subject; also those on the same subject on p. 194 and on "Handling Day Labor in Holyoke, Mass.," p. 202. "Cost of Engineering for Municipal Improvement Project," p. 346, briefly states a method of analyzing engineering charges and refers to earlier articles on the subject. "How to Procure Good Bridge Plans," p. 268, gives some data on fees for the work.

In vol. xxxvii are "Municipal Engineering in Portland, Ore.," pp. 155 and 334, and a report of a decision that "Council Cannot Make Unreasonable Reduction in Salary of Public Officer," p. 404.

In vol. xxxvi a review of the Hartford, Conn., city engineer's report, on p. 123, gives cost of the city's engineering; cost of asphalt plant engineering is given in article on "The Municipal Asphalt Plant of Detroit, Mich.," on p. 143; some data are given in "A Municipal Business Manager in Staunton, Va.," p. 279.

In vol. xxxv are some data in "Cost of Road Building," p. 78; "Engineering Fees for Street Paving," p. 181; also in a review of the annual report of the city engineer of Portland, Ore., on p. 259.

In vol. xxxiv, p. 365, is an article on "Lot Surveys by the City Engineer," which gives prices for this sort of work.

In vol. xxxiii, p. 412, is a little information in an article on "Comparison of Cost of Gravel Roads in Maryland and in Indiana," with references to earlier articles giving more data.

In vol. xxxi, p. 48, is a statement of cost of engineering in "The Sewage Disposal Plant at Downer's Grove, Ill."

In vol. xxx, p. 223, is an article on "Engineering Contracts," which gives some good instruction in respect to its subject. Cost of engineering in Pasadena, Cal., is given in a review of the auditor's report on p. 378.

Gas Lighting Franchise in Hanover Germany.

The Imperial Continental Gas Association of London recently contracted with the city of Hanover to pay $2,380,000 for an extension of its franchise to 1950. Hanover proper has slightly over 300,000 population. Under the old franchise the company paid the city a royalty of $0.0071 on each cubic meter of gas sold to the consumers, which is to be increased after 1925 to $0.0095. If the consumption exceeds 55,000,000 cubic meters, the royalty is to be $0.0107, and if exceeding 70,000,000 cubic meters, $0.0119 per cubic meter. At the conclusion of the contract, which was to run until 1925, the works, mains, offices, etc., were to be turned over to the city; but the city was to provide the capital for extensions and improvements during the last five years of the contract wherever expenditures exceeded $11,900.

In the new contract the city grants the substitution of a calorific test instead of an illuminating power test, the removal of the sulphur restrictions, and the introduction of a uniform price of $0.0333 per cubic meter, with discounts according to quantities used.

Public lighting is to be free and may be increased by 200 lights annually. All property is to be handed over to the city free of charge at the expiration of the franchise. In case another gas plant is needed, the city contracts to furnish the site with rail and water connections free to the company.

FROM WORKERS IN THE FIELD

Practical Points from Practical People.

Contributions to this Department are invited.
Give from your experience for the benefit of others.
Never mind style of composition, the fact is what is wanted.

Asphalt Production in the Past Year.

Aside from its financial features, the annual report of the General Asphalt Company (owning the Barber, Trinidad and Bermudez companies), issued May 14, contains information of interest especially to the paving and road-building industry. The total volume of business increased from $16,004,173 to $16,542,281. For the first time in the company's history the item "asphalt," which includes crude and refined asphalt and asphaltic products in all forms, exceeds the paving account. Sales of asphalt increased from 247,491 tons in 1910 to 265,677 tons in 1911. Thus, while the consumption of asphalt increased in the amount just stated, and produced a revenue increase of $2,297,030, the paving done by the company shows a slight decrease, owing to the fact that a greater proportion of asphalt construction is done by customers of the company using Trinidad and Bermudez asphalts rather than by the company itself.

A full account is given of the development of Trinidad oil, which, the report states, is already being produced at the rate of 200,000 barrels annually, and is being increased. Experts who have surveyed these oil properties estimate the oil available at 250,000,000 barrels.

Manufacture and sale of asphalt products, of which the largest item is roofing, amounted to $1,379,245 in 1911, an increase of $173,844 over 1910.

Floor for Highway Bridge.

To the Editor of MUNICIPAL ENGINEERING:

Sir—Answering request in May issue for suggestions as to new floor covering for a bridge on which old plank are now in use, we wish to report that we have re-covered more than fifty bridges of this type during the past ten years with our creosoted wood block on creosoted plank foundation.

We would suggest that in place of the 4x 14-inch floor stringers now in use, there might be used an 8 or 10-inch I-beam of proper cross-section bolted to the present floor girders, and the 3-inch creosoted plank laid and fastened directly upon the iron I-beams, and the 3-inch paving block laid directly on the plank, and, after being laid, the joints to be filled with paving pitch poured hot over the surface and raked in the joints.

If thought advisable to give crown to roadway, steel or iron shim plates of varying thickness should be fastened under ends of I-beams over floor girders. This will give you 14 or 16 inches above level of top of floor girders instead of 17 inches, now in use.

If the lowering of present roadway on the bridge is desirable in order to change grade of approach, as is sometimes advisable, the I-beams may be fastened to angles or brackets riveted to the web of the floor stringers, in which case the grade of roadway on the bridge may be lowered from 6 to 12 inches below present level.

UNITED STATES WOOD PRESERVING CO.,
By DAVID E. OLDS,
New York City.

Handling Fire in Copenhagen by Pre-arranged Plan.

To the Editor of MUNICIPAL ENGINEERING:

Sir—The undersigned is not in any way connected with the fire department nor with the concerns making fire machinery, but having come across the enclosed article by A. E. Friis about a fire in Copenhagen, Denmark, I have translated it (with a few omissions), thinking that certain points in it might be of interest to municipal officials here.

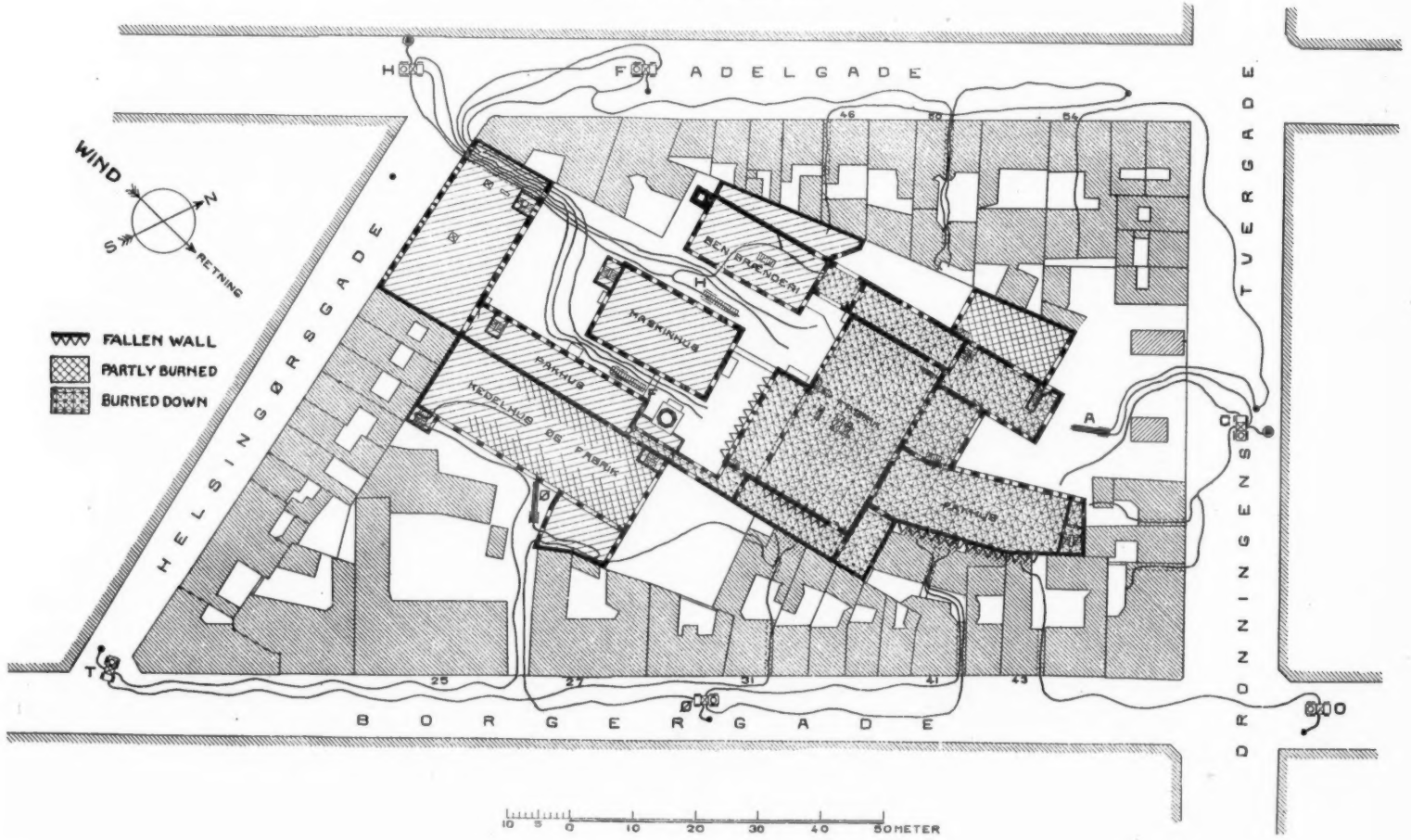
The conditions are, of course, in many respects different from here: building laws are much stricter in Copenhagen than in Chicago (for instance, no wooden houses are allowed), and are enforced to the letter; there is no building of more than six stories in the city, etc. Therefore the fire department in Copenhagen ordinarily is not kept as busy as in a large American city. The population of Copenhagen is 500,000.

NIC L. FEILBERG,
Mech. Eng., A. M. Am. Soc. Refr. Eng.
Chicago, Ill.

The night between February 3 and 4, fire broke out in Helsingoergade sugar refinery, and this developed into the biggest fire the city of Copenhagen has seen since the burning of Kristiansborg castle in 1884. The fire department worked according to a plan of attack previously arranged, and followed it up successfully in every particular.

The sugar refinery proper forms the central part of a complicated system of build-

COPENHAGEN FIRE PLAN.



ings of the plant. Here the large storage of sugar and the many wooden constructions, coated in sugar, afforded the fire good conditions for spreading fast; and crowded in as the plant is between the narrow streets Adelgade and Borgergade, difficult of access from almost every point, a serious fire in it would always be a danger to the neighborhood.

Realizing this, the fire department had worked out in advance a plan of attack for this plant, the same as it has for certain other factories, theaters, storage houses, etc., where a fire would have a good chance of attaining big and dangerous proportions. This, however, is the first time there has been an opportunity to test such a previously arranged plan.

The alarm was struck at 2:30 a. m. When the fire engines arrived, the refinery building was one mass of fire, sending up an immense amount of smoke, and some flames reaching a height of about 100 feet. Men, engines and the other material marched up according to the plan, without a single hitch, first three engines, then two more, and finally, as a reserve, the engine from the navy yard, with an officer and thirty sailors.

The map shows how the fire was attacked, when at its maximum. The wind was toward Borgergade, and for a while compelled the firemen to withdraw to positions farther away than those first occupied; also falling wall parts endangered the work from this side.

In the fire walls that divided up the buildings, there were "fireproof" doors of double steel plate, but they proved insufficient as the high temperatures finished them up completely.

The water supply was satisfactory. It will be noticed from the map that two of the engines, C and I, received their supply from special hydrants, shown as double circles. These two hydrants are directly connected to the large water main, while the other fire hydrants are simply connected to the street line. Such special hydrants, with direct connections to the large water mains, have been put in place near all buildings that may be considered liable to cause big conflagrations. The water works had three more pumps going than under normal conditions.

The force, under the chief's personal command, was five officers and eighty-seven men. The work was considerably handicapped by the cold weather (—4 degrees F.) At 6 a. m., the fire was so well under control that there was no more danger to other buildings. Not a single life was lost.

A. E. FRIIS.

Portland Cement and the Catskill Aqueduct.

Portland cement has been found of so great importance in connection with the construction of the great aqueduct which is to bring water to New York City from the Catskill mountains, a hundred miles away, that it is quite possible that the work would have been an entirely impracticable proposition without it.

Everywhere the great conduit is being lined with cement or is being constructed entirely of concrete. Thus there are long stretches where there is little or no upward hydraulic pressure. In such situations the aqueduct is a solid concrete tube. At other places the waterway goes below the hydraulic grade. In quite a number of such cases the aqueduct sinks far below the hydraulic grade and passes through solid rock. Here the inevitable irregularity of wall is smoothed by the use of Portland cement or concrete. Indeed, in one such case, that of the Rondout siphon, where the aqueduct drops 500 or more feet below the general surface, Portland cement was found of great value in the sinking of a temporary construction shaft. This shaft, when completed, was 500 feet deep. A great quantity of water had to be dealt with, not only at the time when the shaft would reach a water-bearing stratum, but in some cases before such penetration. The water would come in through explora-

KENSICO SIPHON.
Showing Temporary Manhole.

tory holes. Altogether, the shaft was flooded six times during construction. Portland cement grout put down ahead and under pressure was one of the two great factors in the actual conquest. The other great factor was the pumping plant, installed in a special chamber off to one side of the shaft, at a point about 300 feet below the surface. This plant was quite a powerful one, consisting of three horizontal condensing pumps of a combined capacity of 1,050 gallons per minute, furnished by the Cameron Pump Works, New York City. Three 100-h.p. boilers set up on the surface supplied the steam. After the installation of this stationary plant no flooding of the shaft occurred.

Cement is making possible the use of steel

tubes at numerous points where the valley to be crossed is narrow. After the steel tubes are laid, they are covered outside with a thick envelope of concrete and inside by a 2-inch coating of cement grout. This is probably the first time in history that the steel pipe and cement have been combined on such a scale. If this type of construction proves thoroughly satisfactory, a large field for the application of steel pipe will be opened up. The problem involved relates to expansion and contraction. While the coefficients of linear expansion for concrete and for steel do not greatly differ, being respectively about 0.0000055 and 0.0000066 per Fahrenheit degree, they do differ somewhat, and the question is whether this difference will produce bad results. The largest of the steel tubes has a diameter of 11¼ feet. The circumference is, accordingly, about 35½ feet. An increasing temperature change of 100 degrees will tend to result in a tube having an increase in circumference of 0.023 foot, or 0.276 inch. The interior shell of cement will tend to have a circumferential increase of 0.020 foot, or 0.240 inch. That is to say, the interior cement shell will expand circumferentially 0.036 inch less than it should to keep pace with the steel tube. The reverse will be the case with the steel tube and the exterior covering of concrete. With a decrease of temperature of 100 degrees, the steel would tend to contract the inside coating of grout and to shrink away from the concrete on the outside. Now, it is hardly expected that a change of 100 degrees will take place under ordinary circumstances. The water flowing through will act as a temperature control. However, there are the atmospheric changes on the outside. Further, there will perhaps be periods when repairs are being carried out, during which time there will be no water present. On the other hand, it may be that the grout and the concrete possess within themselves the capacity to permit the variations without fracture. The actual results that will be disclosed in the future are of practical importance. It may be added that the interior shell is being put in solid, with no provisions for expansion and contraction. Section joins section, and they are made, in fact, integral with each other. There is, perhaps, no other way.

BRYN MAWR SIPHON.
Placing Concrete Envelope Around Steel Pipe.

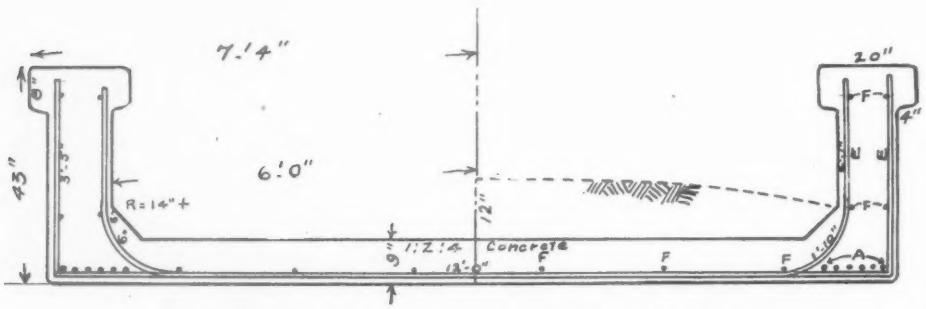
Construction and Cost of Reinforced Concrete Girder Highway Bridges.

To the Editor of MUNICIPAL ENGINEERING:

Sir—During 1911, Halifax County, Va., built, as permanent improvement, three 30-foot reinforced concrete through-girder highway bridges with 12-foot clear roadways. The total contract price was $1,650, and the average price $550. The local conditions were practically the same; the height of abutments from bed of stream to bottom of girders being 7 and 8 feet, and foundations resting on blue clay mixed with some sand and gravel. Two-inch sheet piling was driven on front and sides to a solid bed, and an 18-inch footing course about 5 feet wide was laid. An "U" abutment was built on this foundation, set 6 inches from edge of foundation; and being 15 inches wide on top, vertical back, and ½ inch to 1 foot batter front and ends. Several ⅝-inch round rods were placed horizontally, bent into the wing walls and two extending from foundation diagonally through wings up to face of abutment fastened to horizontal rods. About 10 cubic yards of 1:3:6 concrete with about 10 per cent. of boulders was required for each abutment.

The superstructure consisted of two side girders, 43 inches high, 20 inches wide on top, web 12 inches; and a 9-inch flat slab floor flush with bottom of girders, reinforced with ⅝-inch round rods, spaced 6 inches, and ¾-inch round rods longitudinally every 2 feet. The lateral rods were 19 feet and 4 inches long, bent up vertically into girders, alternately inside and out. The main girder reinforcement was six 1-inch square rods 22 feet long, alternating 10½ feet from either end of girder. Four ½-inch square rods, 12 feet long were clamped at short ends of large bars, and bent up in pairs diagonally, to 2 inches and parallel with top of girder. Six hundred chairs were used to clamp rods in place, and hold steel up from forms. One bridge required 20 cubic yards of 1:2:4 concrete and 2,600 pounds of steel. Cement costs $2 per barrel delivered, stone (¼ to 1 in.) from $1.50 to $2 per cubic yard, and sand 50 cents per cubic yard.

In design of girders the following values were taken: Live load, 150 pounds per square foot; fs, 16,000 pounds; fc, 600 pounds; p, 0.0068; n, 15; k, 0.36; j, 0.88. The false work consisted of 1-inch oak covered with building paper on 2x12 stringers spaced 2 feet on sides and 2½ feet between, on centers; resting on a center pile bent, knee-braced at quarter points. This was left in place for 60 days. Each bridge was cast in one operation, usually in less than 10 hours with eight men. The roadway was surfaced with 12 inches of gravel instead of macadam. Traffic was allowed across the bridges within 10 days after casting.



CROSS SECTION OF REINFORCED CONCRETE GIRDER BRIDGE.

CONCRETE GIRDER BRIDGE.
Near Pulaski, Va.

G. H. DERRICK, M. Am. Soc. C. E.,
Pulaski, Va.

MUNICIPAL MATTERS IN COURT

Higher Courts.—Highway Cost Apportioned to Municipalities.—Peoria Electrolysis.

Decisions of the Higher Courts of Interest to Municipalities.

If Sewer Fund Proves Insufficient, the General Fund May be Drawn Upon.—The charter of the city of Rome, as amended, creates a board of water and sewer commissioners, and authorizes it to contract in the name of the city for the water and sewer systems, that all moneys received by it from bond issues, etc., shall be kept to the credit of the water funds by the city treasurer, and paid out only on warrants of the board, and also requires the board to pay from such fund the cost of constructing an additional water system. Held, that a claim allowed by the board of audit for extras furnished under a contract with the board of water and sewer commissioners for the construction of a sewer system was payable from the fund provided for its construction, if it was adequate, and not out of the general fund.—People ex rel. Carey Construction Co. of Rome v. Smith et al. (N. Y.) 134 N. Y. S. 319.

Private Water Company Subject to Tax to Support Municipal Water Works.—Where plaintiff, a domestic water works corporation, furnished water to a village under a franchise, and thereafter the water supply became inadequate, whereupon the village obtained the right to construct and operate a municipal water works system, which was adequate for domestic purposes and fire protection, and resulted in a reduction of insurance premiums, complainant was not thereafter entitled to restrain the village from enforcing taxes against complainant's property, levied for the purpose of installing and maintaining such municipal water works.—Beauty Spring Water Co. of Lyons Falls v. Village of Lyons Falls (N. Y.) 134 N. Y. S. 290.

Insufficient Income Grounds for Receivership for Water Works Company.—An amended bill for a receiver of a water company alleged insolvency, and that the income of the plant for supplying water for municipal and private purposes was about $1,900, while the annual expenses of operation were about $600, leaving a margin for necessary repairs and improvements of $1,300, which was more than absorbed by interest payable on bonds of the company, etc. It also charged that the plant was in great need of repairs, which could not be made, because there was no one within the state with authority to provide therefor, and that a failure to appoint a receiver would result in great detriment and loss to stockholders and creditors, and would leave the city without adequate water supply, etc. Held, that the bill was sufficient to justify the appointment of a receiver with limited powers.—Thoroughgood v. Georgetown Water Co. (Del.) 82 A. R. 689.

Municipality Not Liable for Negligence of Independent Contractor.—A city, employing an independent contractor to construct a water works plant pursuant to reasonably proper plans, not contemplating an interference with the premises of an individual, and not such as to make necessary, with the ordinary care, any damage to such premises, is not liable for damages to the premises caused by an overflow in consequence of the act of the contractor in breaking a culvert and leaving ridges of dirt preceding a rain, causing an overflow of the premises.—Sappington v. City of Centralia (Mo.) 144 S. W. R. 1112.

Municipality is Responsible for Proper Construction and Maintenance of Sewers.—P. J. Ibach, who is a florist at Logansport, brought action in the Cass circuit court to recover damages which he avers were sustained by him on account of the negligent construction and maintenance by the city of a certain sewer in the territory in which his greenhouse is situated, whereby sewer water was caused to flow into his furnace, putting out the fires, and causing many of his plants and flowers to become frozen. In ordering the construction of a sewer, a city exercises its governmental power as to which it cannot be held responsible for negligence, but the actual construction is ministerial in character, and the municipality may be held for injuries from a failure to do the work in a proper manner, or from improper maintenance.—City of Logansport v. Newby (Ind.) 98 N. E. R. 4.

Contractor May Not Collect for Partial and Unnecessary Performance.—One is not allowed for a partial performance of an indivisible contract for cleaning out a drain-

age, at a certain price per rod, for the necessary distance to be covered, by a verdict for less than the distance claimed to be cleaned; the contractor not being entitled to recover for work as to any of the distance not reasonably necessary to be cleaned.—Colwill v. Urbana Construction Co. et al. (Ia.) 135 N. W. R. 76.

Exclusive Franchise Not Valid.—A municipality owning the source of a water supply and part of the mains granted to a citizen, his heirs and assigns, the right and privilege to supply the city and the inhabitants thereof with water for domestic and other uses, and for preventing and extinguishing fires, and authorized him to use the streets for the laying of mains. Held, that the grant was an exclusive one in the nature of a monopolistic franchise, and so invalid.—Ennis Water Works v. City of Ennis (Tex.) 144 S. W. R. 930.

City Is Not Bound ot Protect Contractors' Employes from Incidental Danger.—A city is not liable for injury to a sewer contractor's employe caused by his foreman negligently directing him to drill new holes in rock near unexploded blasts, on the theory that blasting is so intrinsically dangerous that the city was bound to protect the employe from the incidental danger.—Salmon v. Kansas City (Mo.) 145 S. W. R. 16.

A Deed Given to a City as a Consideration for Right to Lay Water Pipes Does Not Constitute an Exclusive Franchise.—A deed by a real estate company, which platted land and reserved to itself the fee in the streets with the right to lay water pipes therein, which conveyed to plaintiff water company "a right of way" on and under said streets for the purpose of maintaining water pipes and covenanted that grantor would not thereafter vest in any other person or corporation the right to maintain water pipes in the streets, did not give plaintiff the exclusive right to maintain water pipes in the streets, as grantor had a right to itself thereafter lay water pipes in the streets.—City of Norfolk v. Norfolk County Water Co. (Va.) 74 S. E. R. 226.

Notice to Make Repairs Is a Necessary Precedent to Contractor's Liability.—Where a paving contract provided that notice to make repairs should be served on the contractor, the giving of such notice is a condition precedent to the contractor's liability for failure to make repairs.—Asphalt Paving & Contracting Co. v. City of New York (N. Y.) 134 N. Y. S. 433.

Paving Company, Though Dissolved, May Be Held Liable for Repairs.—After the voluntary dissolution of a paving company to which a city was indebted, its vice-president, with the consent of the directors, executed under seal an assignment of its rights against the city to another. Held, that such assignment, being under seal and under the order of the directors, was valid, for a law which was in force at the time of the dissolution, provides that a dissolved corporation shall nevertheless continue in existence for the purpose of collecting its assets, and may sue and be sued for the purpose of enforcing such debts or obligations until its affairs are fully adjusted.—Asphalt Paving & Contracting Co. v. City of New York (N. Y.) 134 N. Y. S. 433.

Additional Water Filters May Not Be Classified and Paid For Under Maintenance Expense.—The Kingston city charter created a board of water commissioners, with power, with the consent of the common council, to construct and maintain a water works system. Section 98 provided that the moneys derived therefrom should be applied to the payment of the cost of maintaining, operating and extending the water works, and to the payment of principal and interest on bonds as they fall due. The board, by section 99, was given power to keep the system in operation independent of the city council, and to fix and collect water rates, and make and enforce rules and regulations. By section 101 the moneys derived from water rates and penalties were required to be paid to the city treasurer, to be credited to the water fund and applied to the payment of expenses of ordinary maintenance and management, the balance, if any, to the payment of principal and interest on bonds, and any surplus still remaining to be used for any lawful city purpose. Held that additional filters, requiring an expenditure of $16,235, was not ordinary "maintenance" expense, and that the board had no power to incur such expense without the consent of the city council.—Coykendall v. Harrison et al., Board of Water Com'rs., (N. Y.) 134 N. Y. S. 446.

A Town Assessed as a Municipality May Not Empty Private Sewage Into a Public Ditch.—Where a town was assessed as a municipality for the construction of a drainage ditch, such assessment gave it the right to drain the surface water from its streets and alleys and public grounds into and through the ditch, but it did not have the right to use such ditch as an outlet for the sanitary sewage from buildings located upon private lots not assessed.—Geiger et al. v. Town of Churubusco et al. (Ind.) 98 N. E. R. 77.

Sewage Discharge Into Streams May Not Be Enjoined Unless Damage is Proved.—Where a municipality, which was entitled to use a drainage ditch as an outlet for the surface water from its streets, alleys and public grounds, wrongfully used the ditch as an outlet for sanitary sewage from buildings located on private property, but such use did not in any way injure the health of the owners or occupants of other lands assessed for the construction of the ditch, the municipality will not be enjoined from so using the drain unless it appears that plaintiff is about to suffer some substantial injury for which there is no adequate remedy at law.—Geiger et al.

v. Town of Churubusco et al. (Ind.) 98 N. E. R. 77.

Precise Form of Drainage Need Not Be Stated By Riparian Owner Seeking Relief From Stream Pollution.—Where the petition states facts sufficient to constitute a cause of action against defendant, in damages, for the maintenance of a public nuisance, Held that it was not material that plaintiff did not demand the precise relief to which he was entitled, or that he mistook the true rule of damages; that he was entitled to whatever legal damages were recoverable for the wrong.—Colbert v. City of Ardmore (Okla.) 122 P. R. 508.

Apportionment of Cost of Highways Against Municipalities.

Legal questions arising from complications in connection with the new county highways which are to run through Watervliet and Cohoes in New York State, have been settled in an opinion given today by Attorney General Carmody.

The resolutions approving the improvement were approved by the Albany county supervisors in July, 1911. The 15 per cent. of the cost heretofore charged to the towns was transferred to the cities and the advertisement of these roads was withheld pending an adjustment of the question of apportionment.

The attorney general holds:

Where a county board of supervisors has adopted a final resolution and approved plans and specifications for improvement of a county highway, there should not be a reapportionment of the cost of construction of such highway so as to eliminate the towns therefrom.

Where the plans for construction of a county highway must be revised and an additional sum is necessary for its construction, such sum should be apportioned between the state and county.

The board of supervisors of a county shall, by resolution, apportion the cost between the city and county of a county highway constructed through or within a city of the second or third class in such county.

The Termination of the Peoria Electrolysis Case.

After fourteen years' litigation, United States District Judge Sanborn decided the electrolysis suit between the Peoria Water Works Company and the Peoria Railway Company in favor of the water company, issuing a perpetual injunction restraining the railway company from allowing its electric currents to damage or interfere with the water mains.

In his ruling, Judge Sanborn said:

The court having found and decided that the complainant water company has been and is being damaged by electrolysis, caused by electricity generated by the defendant, it is decreed that the defendant shall take such measures as to prevent further injury from electrolysis.

The decision of the court is regarded as necessitating complete rehabilitation of the railway properties.

Health Commissioner Sought for City of Boston.

A vacancy will soon exist in the position of chairman of the board of health of the city of Boston.

The duties of the chairman and his two associates are various and responsible. They embrace the control of contagious diseases, including bacteriological tests, disinfection and preventive measures; the inspection of milk, vinegar, provisions, tenements, slaughter houses, stables, and occupations and conditions dangerous to health; the medical inspection of the schools, containing more than 100,000 pupils; the management of a smallpox hospital and a quarantine station; the control of convenience stations throughout the city; the compilation and publication of vital statistics, and other miscellaneous duties. The department has over two hundred employes.

The mayor will consider applications from physicians, sanitary engineers or other persons experienced in this field, who are American citizens.

The salary of the position is now $4,500 per year, but the mayor has recommended an increase to $5,000, and is willing to recommend more.

The appointment is made by the mayor, subject to confirmation by the Civil Service Commission, and the new appointee will serve out two years of an unexpired term. The full term is three years. Applications should be addressed to Hon. John F. Fitzgerald, mayor, Boston, Mass.

Water Main Broken in Sioux Falls, S. D.

The breaking of the 12-inch water main, supplying the east portion of the city of Sioux Falls, S. D., completely shut off the water supply of that section of the city for a number of hours recently. The big main was broken by a pile which was being driven into the ground for the falsework of the new Eighth street bridge.

The breaking of the main was followed by an outburst of water at the place and the reduction of the pressure in the water mains throughout the city from 65 to 15 pounds. Immediate steps were taken by the city authorities to supply the East Side with water, and two lines of hose were connected with the hydrant on the west side and carried across the river to a hydrant on the east side of the bridge. A four-inch main was swung across the river the following morning and connected with the mains on the East Side until the big main was repaired.

STREET · LIGHTING

Alliance Municipal Plant.—Street Lighting and City Growth.

The Municipal Light Plant of Alliance, Neb.

Alliance, a town of about 3,000 population, is an example of a municipality which had municipal ownership thrust upon it. In 1892 a franchise was given to the Alliance Electric Company to operate a lighting plant until 1920. A clause was inserted providing that the city might purchase this plant in 1910 at a price to be agreed upon between the city and the company. In event of a disagreement regarding this purchase price a board of arbitrators was to be appointed to settle a price, which should be binding on both parties.

In 1910 the citizens voted to purchase the plant, the only thing which they could do under the circumstances, unless they waited ten years more. The agreement was negotiated as provided by ordinance, but they disagreed on the price. The arbitrators were appointed according to the provisions of this ordinance, and they returned a decision that the plant was worth $85,000, and named that as the price the city should pay. This was a great surprise to the city by reason of the fact that their valuation had been determined upon a different basis. The city had taken into account only the actual physical valuation of the plant, giving no consideration to the earnings, which formed the basis for the price set by the board of arbitrators.

The decision of the board placed the city in a peculiar dilemma. It could not retire from the trade, being bound by the franchise agreement. It did not wish to pay the large price set by the board of appraisers, as it was far in excess of the physical valuation of the plant. After some further negotiations the city succeeded in getting the price down to $55,000, at which figure, though still in excess of the value of the plant and equipment, the purchase was made.

At the time the city made the purchase they made provision to rebuild the power plant, they assumed a $15,000 mortgage on the old plant, and by doing this they had about $20,000 to apply on rebuilding the power plant. New machinery and a reservoir for fire protection will be added as soon as funds can be provided.

After a little more than a year of successful operation N. A. Kemmish, the superintendent, offers a comparison between the municipally and the privately managed plant. The following figures in both cases consist of the earnings and expenses from operation. The figures given for the Alliance Electric Company are for the year ending February 15, 1911, and in the case of the city they are for the year ending April 15, 1912. The same items of earnings and expenses are included in both cases. In the operating expenses no allowance was made in either case for taxes or depreciation, but maintenance and repairs were included. The taxes of the old company were $300 per year, and were taken out of their operating expenses in order to make fair comparison.

ALLIANCE ELECTRIC COMPANY.

Gross earnings of the Alliance Electric Co.	$32,822.55
For 12 months, operating expenses of Alliance Electric Co.	25,699.83
Gain over operation	$7,152.72

MUNICIPAL PLANT.

Gross earnings of city of Alliance for 12 months	$33,387.93
Operating expenses city of Alliance	22,075.16
Gain over operation	$11,312.77

CHARGES AGAINST MUNICIPAL PLANT.

Depreciation ($50,000) at 7 per cent.	$3,500.00
Interest on $75,000 at 4½ per cent.	3,375.00
Taxes	350.00
Insurance	455.40
Sinking fund to retire bonds	3,652.37
Total	$11,312.77

Number of light consumers, April 15, 1912, 433.

The city has served forty more customers, on an average, or 10 per cent. more than the old company, and with practically the same gross earnings, and the city made over $4,000 more, or 57 per cent. more than the old company.

The citizens and the officials of the department are so well pleased with the operation of the plant that their attention is now turned to securing an ornamental lighting system for their streets.

Street Lighting and City Growth.

BY C. L. ESHLEMAN.

From a paper before the American Civic Association, Washington, D. C.

The value of property on a business street is directly proportionate to the number of people who make use of the street as a thoroughfare. A corner lot on Broadway is worth more than a lot in the latest subdivision on Long Island, simply and solely because a greater number of people pass the Broadway corner during the day. It not infrequently happens that opposite sides of a street on the same block have considerably different values, due to the same cause. Anything which adds to the traffic of a given street must, therefore, add to the value of the abutting property. While conditions of accessibility to necessary utilities, such as railway stations, hotels, banks, public buildings, etc., have doubtless a preponderating influence in determining the traffic of a street, it is equally true that no subsidiary condition has such a vital effect as the lighting.

The merchants on one of the main business streets of a large eastern city saw that the bulk of traffic failed to pass them in the natural course of business. They installed a brilliant system of street lighting, and forthwith their street became the center of attraction; and similar instances can be cited in numerous other cities. It would, of course, be absurd to expect to create a popular business street out of a thoroughfare lying far beyond the natural limits of traffic; but there is no question that any street directly tributary to a business thoroughfare can be fully doubled in value by the installation of spectacular lighting.

In a more general way, lighting the entire business section of a city up to the standards of modern illumination does for the city, as a whole, what the lighting of a particular street does for that section—it increases values by increasing the traffic, not only from the city itself, but from the surrounding country and nearby towns. That good light increases the value of residential streets by making them more desirable needs no argument. Good street lighting, more than any other thing, gives to a city an air of progressiveness and prosperity.

It would doubtless be stretching the argument to claim that better street lighting would directly add to the healthfulness of the street. The power of suggestion in influencing action, however is no mere fancy; there is no denying the fact that one improvement suggests another. Improved forms of paving have produced cleaner streets, not merely because such streets are easier to clean than cobble stones, but, because of their much more elegant appearance, they show more strikingly the offensiveness of filth and neglect. The same reasoning applies with greater force to the lighting of a street. Not only will well-lighted streets be kept cleaner, as a matter of mere inclination, but they will be less littered and abused. There is extremely little wanton destruction or injury to property of any kind. Such cases arise mostly from thoughtlessness or association; and not only will good street lighting be an incentive to keeping the streets clean and sanitary, but will further react upon the residents themselves with a wholesome influence to cleanliness.

Before the days of systematic street lighting, only those ventured out at night who had urgent business or ample bodyguard. City streets have become safe as they have been well lighted. It is true that light alone would be insufficient protection, but it is equally true that police alone, in any reasonable numbers, cannot afford complete protection.

While this fact is generally recognized, there is one phase of the matter, on which more public education is needed. It is the practice in many cities, especially the smaller, to extinguish a considerable portion of the street lights at midnight or thereabouts, thus leaving them without this important protection for half of the night. To be sure, many streets are little frequented during this period; but a single breach of public order resulting in robbery or murder would more than offset the additional expense involved. A city in these days can certainly afford—and the citizens reasonably expect—to have the fullest possible degree of protection every hour of the day. The midnight schedule is a piece of petty economy entirely out of keeping with the wealth and civilization of our country at the present time.

What is called the moonlight schedule is even a greater fallacy, if literally carried out. Moonlight is far too uncertain a quantity to be reckoned with in so vital a thing as street lighting. A city should not only be lighted up adequately in every part, but should be kept lighted up during the entire part of the twenty-four hours when sunlight is not available.

Although "ornamental lighting" has been in vogue for many years, it has remained for the last two years to bring about definite and positive developments in this line. Before passing to a detailed description of the present street lighting practices, it might be well to take a casual glance at several forms of lighting that have been popular in past years. Successive developments in underground service have brought about successive developments in decorative lighting. Approximately ten years ago the change from overhead wiring to underground brought about the change from arc lamp span, or center street suspension, to suspension from more or less ornamental shepherd's crook poles. A number of notable installations placed at that time are still in service.

Following the pole suspension of inclosed arc lamps, we find the growing popularity of the festoon system. This consists of a carnival effect produced by stringing streamers

of incandescent lamps either across the streets or parallel to the curb lines. Streamers were installed to produce a spectacular effect during a short period of festivity and then removed.

The festoon idea naturally developed into a more permanent system in the form of steel arches suspended across the main business thoroughfare. Installations of this nature produced definite night results, but the effect by day was not altogether pleasing. An ornamental lighting system must be esthetic as well as utilitarian.

The advent of high efficiency arc and tungsten lamps has revolutionized outdoor as well as indoor lighting, and has opened up worlds of possibilities. These high efficiency units make it possible to produce, not only spectacular, but highly ornamental effects—the production of illumination instead of simply light, the substitution of glow for glare.

An analysis of present business district lighting reveals two definite forms of installation:

1. Flame lamp or high efficiency metallic electrode lamps, suspended from ornamental poles.

2. The tungsten cluster or ornamental standard system.

Fifty to 100 feet spacing is common practice, 50 to 60 feet giving excellent illumination; 70 to 80, good; 90 to 100, fair. With 60 to 66-foot streets, units should be placed opposite each other and spaced 60 to 66 feet apart on both sides of the street. On wider streets units should be spaced correspondingly closer. The following is a general rule that can be followed to good advantages: The spacing of lighting units should be inversely proportional to the width of street. In small cities and towns having comparatively narrow streets (30 to 50 feet in width) good results can be obtained by staggering the lighting units, the distance between units on same side of street being 90 to 120 feet.

The foregoing discussion has dealt largely with business district ornamental lighting. Space will not permit a detailed discussion of systems available for residence districts, parks or boulevards. In a word, let us say that single unit series lighting should be adapted for these purposes.

An ornamental lighting installation reflects credit upon the city, pleases the people, increases business and begets a desire to improve the general lighting of the entire city. The opportunity is here; the means of making it golden are within easy reach. Don't neglect it.

French Experiments with Tarred Roads.

In a report made to the French Academy of Science particular attention is drawn to the danger to the eyes from dust arising from tarred roads. To determine the effect, mixtures of fine road dust, to which tar in varying proportions was added, were made up, and the eyes of rabbits dusted with the mixtures. The results were conclusive. While the pure road dust had little or no effect on the rabbits, their eyes were greatly affected by the presence of tar, and serious diseases broke out after these applications, showing the noxious effect of the tar.

Tarring produces good results only if the roads are well built and in repair, and composed of sufficiently hard materials; if the tar fully penetrates the crevices and does not form an external crust which the first winter rains would raise up and transform into mud; and, finally, if the drying conditions during the bad season are satisfactory. With these few restrictions, it may be said that tarring effectively protects the surface of highways against motor car traffic, and even against ordinary traffic if the latter be not extraordinarily heavy.

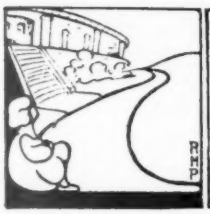
The use of superficial tarring is becoming more and more extended, principally in the neighborhood of Paris. In the St. Etienne district and other parts of provincial France, progress has been slower except near a few large industrial centers. However, a certain increase in the mileage of tarred roads was reported from 1908 to 1909. The appropriation allowed for these experiments in 1909 in twenty-four departments amounted to $19,077, covering seventy-eight miles of tarred roads, compared with 46.5 miles in 1908.

In the Department of Loire the tar is spread hot by hand or by a spray. Another method consists in rendering cold tar fluid by the addition of 10 per cent. of crude oil, and spreading it by the same means as the hot tar.

In the Department of Seine et Oise recent experiments have been made with divers tar and oil emulsions; deliquescent salts also have a real effect, but unfortunately of short duration, so that they can be employed only for special occasions, such as fetes, races, etc. This department employs every year solutions of calcium chloride for watering certain sections of the roads which are not in a sufficiently good condition to receive a coat of tar, at the cost of 2 cents per square meter (1.196 square yards). If the weather is too dry, the road is sprinkled with ordinary water.

Chloride of magnesium produces the same results, but the price is higher. It is used in Germany, where 3 per cent. solutions (because of their low congealing point) lay the dust in the streets during winter. Emulsions such as westrumite and similar products appear to be abandoned of late because of their high price and short duration.

In France a few experiments have been made with crude petroleum, so much employed in America, but they were not continued on account of the high cost and the inconvenience of the mud, which appears with the autumn rains.



ORGANIZATIONS & INDIVIDUALS

Electric Railway Association.—Brooklyn Engineers' Club.—The American Water Works Association.—American Society of Civil Engineers.—The American Road Builders Association.—Conference on City Planning.—International Association of Road Congresses.—Technical Associations.—Technical Schools.—Calendar.—C. H. Rust.—Personal Notes.

Tour of the American Electric Railway Association.

The officers of the American Electric Railway Association and the American Electric Railway Manufacturers' Association have completed an 11,000-mile tour of the United States. The journey took in cities as far south as Galveston, as far west as San Francisco and Los Angeles, and as far north as Vancouver, B. C., starting from New York City. The objects of the tour were threefold:

(1) To confer, not only with electric railway managements, but also with representatives of public utility companies in all lines, and with public officials and civic bodies and citizens generally on the subject of the relations between public service corporations and the communities they serve.

(2) To cultivate closer relations with the remote members of both associations.

(3) To enlarge the membership of both associations.

Thomas N. McCarter, of Newark, N. J., is president of the American Electric Railway Association, and H. C. Donecker, of New York, is secretary and treasurer.

Brooklyn Engineers' Club's Materials Exhibit.

The Brooklyn Engineers' Club's second annual exhibit of engineering materials, processes and models was held at the club house, 117 Remsen street, Brooklyn, N. Y., during the latter part of April. There were twenty-six exhibits, and each exhibit was accompanied by its own expert, who gave ten-minute talks each evening with his demonstration. The show was free to the general public, and no charge was made by the club to the exhibitors.

The exhibits varied from a model of the Piercy patent locomotive stage, conceived in South Africa and not yet adopted in America, to the Chambers fireless cooking gas range. The Thermit process of welding was one of the live exhibits of the week, and frequent demonstrations were made of the production of liquid steel at a temperature of 5,400 degrees Fahrenheit from a powder composed of iron oxide and finely divided aluminum.

The library on the second floor of the club house was given over to the exhibits of instruments of precision, while the parlors in the rear of the library were taken up by the exhibit of the Brooklyn Bureau of Highways, showing by charts Brooklyn's permanent pavements in comparison with other large cities. The New York fire department was represented by Deputy Commissioner P. P. Farley and Chief P. J. Graham of the repair bureau, both of whom gave talks concerning the more recent inventions adopted by the department.

The American Water Works Association.

The thirty-second annual convention of the American Water Works Association will be held in Louisville, Ky., on June 3-8. A very interesting program of papers, discussions and entertainment features has been outlined.

Among the papers to be presented are the following:

Ancient and Modern Water Works, by Edward Wegman; Floor Area Unit as a Basis for Estimating Consumption, by William W. Brush; Ice Troubles at Buffalo, N. Y., by Henry W. Lyon; A Method of Increasing Depth of Large Wooden Settling Tank, by A. H. Meyers; How We Crossed Two Streams with Ward Pipe at Rome, Ga., by M. L. Worrell; More Than Fifty Years' Reminiscence in Water Works, by H. G. H. Tarr; Progress of the Adoption of the National Standard Hose Couplings and Hydrant Outlet, by F. M. Griswold; Organization of the Bureau of Water Supply of the City of New York, by I. M. de Varona; Philosophy of Purchasing Supplies, by Elihu Cunyngham Church; Efficient Management, by Harrington Emerson; Steam Turbines and Centrifugal Pumps, by W. O. Berg; The Cost of Water, or Is It Worth While to Stop Waste, by Edward S. Cole; Method of

Locating, Measuring and Repairing Leaks in Distribution System at Lancaster, Pa., by F. H. Shaw; Results of Chlorination at Cleveland, O., by D. D. Jackson; Hypochlorite Sterilization at Kansas City, Mo., by S. Y. High; Water Softening at Owensboro, Ky., by E. H. Breidenbach; Electrolysis from Stray Railway Currents, by Prof. Albert F. Gand; To What Degree Must Sewage be Purified, by Chester G. Wigley; A Reliable Quantitive Test for B. Coli, by Shepperd T. Powell; Currents in Tropical Lakes, by John R. Downes; Wood Stave Water Conduit at Atlantic City, N. J., by L. Van Gilder; What is a Fair Rate for Cities, by Alexander Potter.

American Society of Civil Engineers.

The forty-fourth annual convention of the American Society of Civil Engineers will be held at Seattle, Wash., June 25 to 28, 1912. The local committee consists of eight members with Samuel H. Hodges as chairman.

The program includes papers by R. H. Thomson on "Pacific Coast Engineering," on "Harbors of the Pacific Coast," on "Irrigation," and one by a California member not yet announced. There will be the usual excursions to points of engineering interest, including the navy yard, creosoting plant, sawmills, shipp-building yards, Tacoma, Snoqualmie Falls power plant, logging camp, park system, Hood's Canal, Victoria, B. C., Mt. Rainier, and Alaska.

Rates will be the regular summer excursion rates with a probable special train from Chicago, if enough reservations are made.

Charles Warren Hunt, 220 W. 57th St., New York, is secretary, and will give full information.

American Road Builders' Association Remains Independent.

The American Road Builders' Association seems to have come to the conclusion that the chip which it has carried on its shoulder in rather conspicuous fashion has been knocked off, and it has refused to affiliate with the other organizations interested in holding a joint congress. There has been quite a pronounced tendency in this organization to restrict its membership to carefully selected approvers of the course taken by the board of directors and it is not surprising that the board finds itself unable to control the far larger membership of the other organizations interested in the cooperative movement.

The Road Builders have not always held themselves independent of special interests although their work has in general been very satisfactory, in technical quality as well as in the line of promotion. While they will be missed as an organization in the Road Congress of next year, it is quite possible that their places can be filled by individual memberships, even from the ranks of the seceding association.

MUNICIPAL ENGINEERING will do its best to secure publicity for the good things proposed or actually done by all the organizations and regrets that temperamental differences have made a break which will duplicate activities and therefore cause considerable waste both in the organizations themselves and among those who will try in the future as they have in the past to promote the cause of good roads even under disadvantages which seem to them so easy to remove.

Fourth National Conference on City Planning.

The Fourth National Conference on City Planning was held in Boston, Mass., on May 27-29, and was largely attended. In connection with the meeting an exhibit of city planning, illustrating the program of the conference, was held in the Boston public library.

The program this year was peculiarly practical and appealed alike to engineers, architects, landscape architects and students of sociological problems. There was an attempt to show just what city planning can do for certain types of areas and how the bills incident to improvement or reconstruction can be paid. Group sessions on city planning and housing and on city planning and the problem of circulation were held. The following subjects were discussed: 1. The Meaning and Progress of City Planning. 2. City Planning Studies of Specific Areas. 3. How the City Planning Bills are to be Paid. 4. The "Zoning" principle of Germany applied to the United States.

F. Shurtleff, 19 Congress street, Boston, Mass., is secretary of the Conference.

International Association of Road Congresses.

The third meeting of the International Association of Road Congresses will be held in London in June, 1913. Paris was the first meeting place in 1908, and Brussels was the second in 1910. Both of these meetings were most successful, and great interest is aroused in the London congress of 1913.

The purpose of the Congress is the consideration of "the best ways and means of coping with the great wear and disintegration of roads caused by the increase of vehicular traffic, more especially of motor traffic, which has taken place in recent years."

Full reports of the discussions and decisions of the congress, and complete sets of the various papers on different subjects will be published. These papers will comprise reports by leading authorities from all parts of the world, experiments and recent experiences in road engineering, methods of preventing dust and mud, the laying of light railways and tramways on roads, the

choice of surfacing materials, the influence of weight and speed of vehicles on roads and bridges, the conditions to be fulfilled by horse-drawn or mechanically propelled vehicles, in order that they may not damage, or suffer damage, from the roads, etc. These papers will, of course, be of great value to not only local authorities, but also to road engineers, motor designers and manufacturers, and to every user of roads who is interested in their proper and efficient upkeep. The membership of the congress is open to all, and all publications will be sent to members.

W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S. W., is the honorable general secretary of the association.

Good Roads Special Delayed by Floods.

Many of the farmers of Texas, Oklahoma, Arkansas, Louisiana, Mississippi and Alabama have been inquiring of the American Association for Highway Improvement in Washington what has become of the "Good Roads Special" which was to have visited their districts on certain specified dates. J. E. Pennybacker, Jr., the executive secretary of the American Association for Highway Improvement, makes the announcement that, owing to the floods along the Mississippi, it was necessary to put the special on a siding, the schedule naturally being disarranged.

The trip of the "Good Roads Special" was arranged as a result of the co-operation of the United States Office of Public Roads and the American Association for Highway Improvement with B. F. Yoakum, chairman of the Frisco lines, who is also a member of the executive committee of the American Association. The full government exhibit, showing the effect of good roads and bad roads with stereopticon views, electric models showing how roads are made and stone crushers at work, is on board the train. H. S. Fairbank, assistant field secretary of the American Association, is delivering lectures from the train, and at every stop is lending his aid in the formation of road improvement associations for the local communities. In his report to Secretary Pennybacker, he says that twenty such associations have been formed already, and that all have become affiliated with the American Association for Highway Improvement.

Technical Associations.

The Tri-State Water and Light Association of the Carolinas and Georgia, after a two days' session at Salisbury, N. C., selected the following officers for the ensuing year: President, W. F. Stieglitz, Columbia, S. C.; secretary-treasurer, J. W. Neave, Salisbury, N. C.

The Southwestern Water Works Association was recently organized in Temple, Tex., with the following officers: President, Patrick Bracken, of Temple; secretary-treasurer, E. L. Fulkerson, of Waco; vice-presidents, Messrs. T. J. Powell, of Fort Worth; R. L. Jones, of Houston; H. L. McDuffie, of Sherman; Thomas Cronin, of Palestine; C. E. Bartholomew, of Austin, and W. H. Butler, of Brownwood.

The regular meeting of the Colorado Association of Members of the American Society of Civil Engineers was held at the Colorado Traffic Club, Denver, Colo., May 11, 1912. The subject "Flumes" was discussed. G. N. Houston, Sec.-Treas.

At the 311th meeting of the New York Electrical Society, held at the Engineering Societies Building, 29 West 39th street, Wednesday, May 15, at 8 p. m. Dr. Charles Proteus Steinmetz lectured on "Wave Motion." George H. Gay is secretary of the association.

The regular monthly meeting of the American Society of Engineer Draftsmen, held on May 16, in the Engineering Societies Building, was marked by the admission to Junior Membership of Miss Marie Oberlander, a student of architectural drawing at Teachers' College, Columbia University. F. F. Hickel, M. E., consulting engineer to the Worthington Pump Co., delivered a lecture on "Practical Applications of the Slide Rule." Walter M. Smyth is secretary.

On account of other conventions in Denver on September 10, the directors of the International Association of Fire Engineers have, at the request of Chief Owens, changed the date of the meeting to September 17-20, James McFall, Roanoke, Va., Secretary.

The Fire Marshals' Association of North America has completed arrangements for the annual convention to be held in Detroit, Mich., July 11 and 12. The following will speak during the two days' session: John W. Zuber, of Ohio, on "Inspection;" J. R. Young, of North Carolina, "Prosecutions;" Joseph Button, of Virginia, "The Criminal Match;" Alfred A. Lindback, of Manitoba, "The History of the Organization," and C. A. Ellison, of West Virginia, "Fire Prevention and Its Effect on the Cost of Fire Insurance."

At the twenty-fifth annual convention of the Montana Society of Engineers, held at Anaconda, the following officers were elected: R. A. McArthur, president; John H. Klepinger, first vice-president; Reno H. Sales, second vice-president; Clinton H. Moore, secretary; Sam Barker, Jr., treasurer.

At a meeting of the city engineers of the state, the Montana Institute of Municipal Engineers was organized. The meeting was held at Helena, Mont., on May 11. Henry Gerharz, of Billings, was elected president; Charles W. Helmick, of Helena, vice-president, and Carl C. Widener, of Bozeman, secretary-treasurer. The officers, with M. L. Morris, of Great Falls, and William McLean, of Lewistown, compose the board of direc-

tors, which was also appointed a committee to draft a code of ethics.

At a regular meeting of the Municipal Engineers of the city of New York, May 22, 1912, a paper entitled, "The Story of the Maine," was presented by Colonel William M. Black, Corps of Engineers, United States Army.

R. K. Brown was elected president of the Utah Society of Engineers at the annual meeting, held in Salt Lake City. E. H. Beckstead and F. D. Ulmer were elected vice-presidents; L. H. Krebs, treasurer, and Prof. R. B. Ketchum, secretary.

Technical Schools.

Work has been commenced upon the construction of the new Ceramics and Mining Engineering Laboratories of the University of Illinois. The contracts for the new Transportation Building and the Locomotive Testing Laboratory will soon be let.

Henry E. Riggs, M. Am. Soc. C. E., of the Riggs & Sherman Co., Consulting Engineers, of Toledo, Ohio, has been appointed Professor and head of the department of civil engineering at the University of Michigan. Prof. Riggs graduated from the University of Kansas in 1886. He spent a number of years in railway work and was for six years Chief Engineer of the Toledo, Ann Arbor & North Michigan Ry. Since 1896 he has been in private practice in Toledo. It is the purpose of the University to expand the civil engineering courses to cover three other departments; a structural engineering course under Prof. A. E. Greene; Fgeodetic surveying under Prof. Clarence T. Johnson, and a course in sanitary and municipal engineering.

Francis S. Foote, Jr., has been appointed associate professor of railway engineering in the department of civil engineering at the University of California. Mr. Foote is at present a member of the instructing staff of the school of Railway Engineering and Administration at the University of Illinois. He is a graduate of Columbia University.

Prof. John H. Nelson has been appointed professor of applied mechanics at the Worcester Polytechnic Institute to succeed the late Prof. Edward L. Hancock. For the past three years Prof. Nelson has been in charge of the department of applied mechanics at the Case School of Applied Science, in Cleveland, and he was also formerly on the teaching staff in mathematics and mechanics at the South Dakota State College.

Calendar of Technical Meetings.

American Water Works Association. Annual convention, Louisville, Ky., June 3-8. John M. Diven, secretary, 217 River street, Troy, N. Y.

Mayors' Conference of New York. Third annual meeting, Utica, June 10-12. Mayor C. C. Duryee, president, Schenectady, N. Y.; C. C. Capes, secretary, New York.

National Electric Light Association. Annual meeting at Seattle, Wash., June 10-14. T. C. Martin, secretary, 29 West Thirty-ninth street, New York City.

New York State Association of Fire Chiefs. Annual convention, Albany, N. Y., June 20-21. U. G. Lucas, secretary, Poughkeepsie, N. Y.

American Institute of Electrical Engineers. Annual convention, Boston, Mass., June 25-28. F. L. Hutchison, 33 West Thirty-ninth street, New York City.

American Society of Civil Engineers. Annual convention at Seattle, Wash., June 25-28. C. W. Hunt, 220 West Fifty-seventh street, New York City.

Society for the Promotion of Engineering Education. Annual meeting at Boston, Mass., June 26-28. H. H. Norris, secretary, Cornell University, Ithaca, N. Y.

National Municipal League. Annual meeting, Los Angeles, Cal., July 8-12. Clinton Rogers Woodruff, North American building, Philadelphia, Pa.

Fire Marshals' Association of North America. Annual convention, Hotel Cadillac, Detroit, Mich., July 10-12. State Fire Marshal Palmer, president, Lansing, Mich.

New England Water Works Association Thirty-first annual convention, Washington, D. C., September 18-19. Willard Kent, secretary. Headquarters, Boston, Mass.

Central States Water Works Association. Sixteenth annual convention, Detroit, Mich., September 24-26. R. P. Bricker, secretary, Shelby, Ohio.

American Society of Municipal Improvements. Annual convention, Dallas, Texas, November 12-15. A. Prescott Folwell, secretary, 50 Union Square, New York City.

New York Fire Exposition and International Conference of Fire Prevention, Protection and Extinguishment. Seventy-first Regiment Armory, New York City, October 2-12. A. D. V. Storey, secretary, 1269 Broadway. New York, N. Y.

U. S. Civil Service.

The U. S. Civil Service Commission will hold examinations as follows:

June 5. Examiner of surveys in the field servce of the Department of Agriculture at entrance salaries of from $1,200 to $1,500 per annum. Computer in the Astrophysical Observatory, Smithsonian Institute, Washington, D. C.

June 10. Chief of drainage investigation in the office of experiment stations, Department of Agriculture, at a salary of about $4,000 per annum.

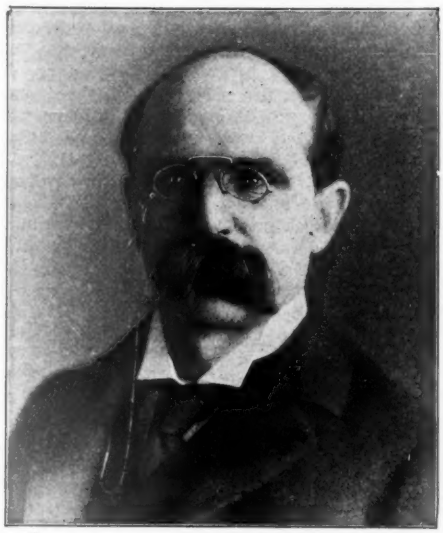
June 12. Laboratory assistant in the Bureau of Standards, at a salary of from $900 to $1,200 per annum.

June 26-27. Assistant to inspector of ordance, War Department, at a salary of $1,200 per annum.

C. H. Rust.

C. H. Rust, who has for the past thirty-five years been connected with the city engineering department of Toronto, Ont., Can., has resigned. For the last fourteen years Mr. Rust has held the position of city engineer, in which capacity he has directed a great many important public works, including extensive sewerage improvements and betterments of the water front.

Mr. Rust was elected a member of the Canadian Society of Civil Engineers in 1887, and in 1901 was made vice-president of that



C. H. RUST.

body. In 1911 he was elected president of this organization. He was interested in other engineering and municipal societies, having been elected a member of the American Society of Civil Engineers, the American Society of Municipal Improvements and the American Water Works Association.

Mr. Rust has been appointed city engineer of Victoria, B. C., Can., at a salary of $6,800 per annum, which is a considerable increase over that of his former position. At Toronto George G. Powell is acting city engineer.

Personal Notes.

James P. Gaffney has been appointed city engineer of Cumberland, Md.

Carr Edwards, St. Charles, Mo., has been reappointed city engineer for a term of two years.

Israel R. Bart has been appointed superintendent of the Armstrong Water Company at Kittanning, Pa.

D. F. McCarthy has been reappointed city engineer and superintendent of streets, sewers and water of St. Albans, Vt.

Theodore A. Leisen has been reappointed chief engineer and superintendent of the water works of Louisville, Ky.

J. R. Ellis has resigned as city engineer of Columbia, Mo., to become assistant city engineer of Regina, Sask., Can.

Albert P. Haines has been appointed engineer in charge of the construction of roads for the city of Fort Worth, Texas.

William H. Connell has been appointed chief of the Bureau of Highways of Philadelphia, at a salary of $6,000 per annum.

C. H. Sweetser, consulting engineer, Olympia, Wash., has been appointed engineer in charge of the construction of highways for Pierce county, Washington.

James E. Carroll, for nine years past city engineer of Crookston, Minn., has been appointed assistant commissioner of public works, of St. Paul, Minn.

Dr. Rudolph Diesel, inventor of the Diesel engine, was elected an honorary member of the American Society of Mechanical Engineers at the meeting held on April 30.

James M. Porter, Pittsburgh representative for a number of paving brick and paving block manufacturers, has removed his office to 1842-43 Oliver building, Pittsburgh, Pa.

A. J. Hammond, consulting engineer of South Bend, Ind., and chief engineer of the Chicago Bureau of Public Efficiency until recently, has been appointed bridge engineer of Chicago. T. G. Pihlfeldt, who held this position for many years, has been retained as bridge designer.

Walter G. Kirkpatrick, Massena L. Culley, John E. McCorkle, Jr., and John R. Baylis have become associated under the firm name of Kirkpatrick, Culley, McCorkle & Baylis, for the practice of engineering in the Southern States, making a specialty of hydro-electric power developments and municipal improvements. The offices of the new firm are at 703 Farley building, Birmingham, Ala. Mr. Kirkpatrick has been engaged in this work for twenty-five years, with an office at Jackson, Miss., and has been recently appointed city engineer of Birmingham, Ala. Messrs. Culley, McCorkle and Baylis have been associated with him in engineering work for a number of years.

As a result of the recent election of a new municipal administration in Milwaukee, a number of changes have been made in the executive offices. Fred G. Simmons has been appointed commissioner of public works. Henry P. Bohmann has been appointed superintendent of water works. F. W. Blodgett, who was at one time engineer of the park board of Milwaukee, has been appointed as superintendent of street construction. C. O. Davis, formerly roadmaster of the Milwaukee Electric Railway and Light Company, has been appointed superintendent of street cleaning and garbage collection. J. C. Pinney, Jr., instructor in bridge engineering at Marquette University, Milwaukee, Wis., has been appointed superintendent of bridges and buildings.

MACHINERY AND TRADE

The National Police Signal System.

A complete telephone system, a light and alarm bell signal, and an automatic recording system are all embodied in the National Police Signal System, of which the first installation was made in Buffalo, N. Y.

An experience of more than twenty years in practical police signal work, coupled with wide technical experience as an electrician, has enabled the inventor of the National Police Signal System to perfect a device that eliminates entirely the register and tape apparatus and substitutes therefor absolute automatic sealed registry of movements of patrolmen to such a degree that the chief or other commanding officer knows at all times, day or night, just where every man on the force is located, and can talk with one or ten or fifty of them on a moment's notice. A patrolman may be summoned at once by gong or flashlight as desired.

The central station switchboard may be arranged for the operation of as many circuits as desired. It is so arranged that telephone communication can be held between any two patrol boxes or from any patrol box to any telephone on local telephone system.

A visible and audible signal is given at the switchboard during the operation of each patrol box, the signals remaining in continuous operation only when telephone communication is desired with the central office, and discontinuing when central office operator answers call. The operation of all patrol bixes is automatically recorded whether attendant is at switchboard of not.

The recorder consists of an electric time-recording device so arranged and mounted that the record remains in constant view for a period of eight, twelve, or as many hours as desired. The importance of having a record in view for a number of hours cannot be overestimated as a mere glance at the record shows every box pulled and enables the central office operator to quickly locate any patrolman. It is impossible for the central office operator to make false record of the operation of any patrol box.

The patrol box is iron clad, thoroughly coated with a moisture and acid proof compound. All apparatus is protected from moisture and dust by the iron case. The apparatus consists of a telephone transmitter, receiver and hook-switch, wagon or emergency call equipment and door switch for disconnecting all the apparatus from the line when outer door is closed. All wagon or emergency calls are automatically recorded.

Associated with each patrol box is a red lamp and a loud ringing bell; these being used to signal patrolman by day or night. As many lamps and bells as desired can be operated from any one patrol box. This permits locating these signals at points of vantage for signalling an officer. The lamps and bells associated with any one patrol box can be operated without operating those associated with any other patrol box, or all the lamps and bells on the entire system can be operated at the same instant.

Several devices have been designed for police signalling, but they are with one exception register and tape systems, and as such, they have many deficiences. The National Police Signal Company have perfected a device that eliminates entirely the register and tape apparatus, and substitutes therefor absolute automatic sealed registry of movements of patrolman to a degree that the chief or other commanding officer knows at all times, day or night, just where every man on the force is located and can talk with one or as many as desired at a moment's notice.

The National Police Signal System is not constructed in series. Should an open circuit or other trouble occur, it can only effect one box. In this system positive indication of an open circuit, grounded lines, etc., are given at the central office, and trouble can be repaired at once.

It is not necessary with this system to telephone a call for a patrol wagon, or to send in an emergency call verbally. The mere pressing of the wagon or emergency call button sends the necessary signal to the central office. This is of great convenience, especially to the patrolman handling an unruly prisoner.

Under this system reserve patrolmen can be sent on regular beats, thereby increasing the efficiency of the force and the efficiency of having men on hand is not impaired in the least as the central office operator can call all the patrolmen at a moment's notice and give special instructions.

The Superintendent of Police of Buffalo, Michael Regan, has expressed his satisfaction with the success of the system, as has

Rhinelander Waldo, Commissioner of Police of New York City. The system is manufactured and installed by the National Police Signal Co., 221 Ellwanger & Barry Building, Rochester, N. Y.

The New Factory of the H. W. Clark Co., Mattoon, Ill.

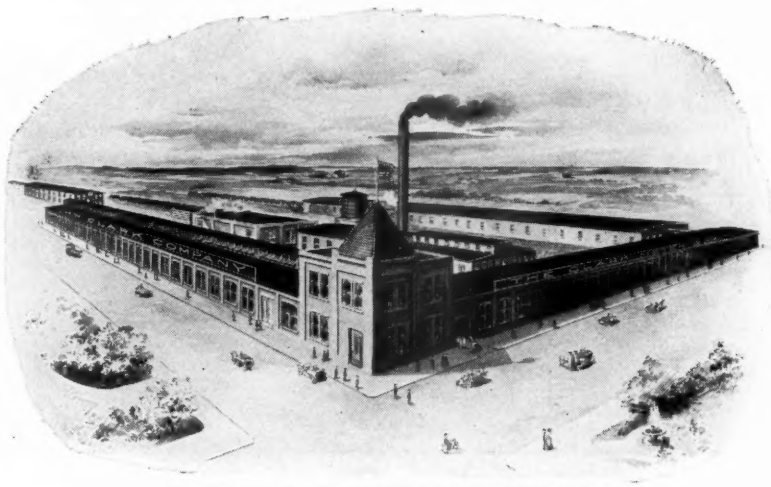
The H. W. Clark Co., of Mattoon, Ill., manufacturers of the Clark meter box and other water works appliances, have been forced to larger quarters by the rapid increase in their business during the past year or two. This new plant and equipment will not only better care for their present large business, but will permit of future growth.

The illustration on this page gives a fair idea of the magnitude of their new buildings, which have a floor space of over 45,000 square feet.

In is their intention to add, at a very early date, several new water works specialties to their line. In addition to their regular large line of meter housings, they are equipped for and are especially solicitous of business demanding special and out-of-the-ordinary requirements in meter box castings to meet local conditions.

The goods now manufactured by this company are known to practically every water works manager and superintendent, the Clark meter box having been adopted by many cities as the standard housing for all meters placed out of doors. They have a style and size of meter box to suit every condition of service and climate, as well as every size of meter or depth of service. Their "Teksagon" meter couplings eliminate the troubles of leaks and choked waterways experienced where gaskets are used. The Clark iron collapsible forms are being used very extensively by water works men who desire to make the box bodies for their meter boxes of concrete. They also manufacture special water works gauges, the "Clark sanitary well construction" and the "Clark perfect double-acting deep well pump plungers."

The company was incorporated a little over a year ago. The officers are: H. W. Clark, president; C. H. Tillotson, treasurer, and Dwight P. Child, secretary. They issue a very comprehensive catalogue, fully descriptive of their line, which will be forwarded to any one interested.



THE H. W CLARK FACTORY MATTOON. ILL.

Northwestern and Miracle Machinery Manufacturers Consolidated.

What is considered to be one of the largest deals ever consummated in the history of the concrete machinery manufacturers, in importance of the transaction, the money involved and in the interests affected, is the consolidation of the Miracle Pressed Stone Co., of Minneapolis, Minn., with the Northwestern Steel & Iron Works, of Eau Claire, Wis., for the manufacture of concrete machinery and tools.

Both concerns are very well known, do a large business and enjoy a high reputation among concrete workers and contractors. This consolidation will give them the distinction of being the largest makers of concrete machinery in the world.

The Northwestern line has been established for the past decade and its concrete making machinery and tools are used in every country on the globe. It meets the big demand for medium priced machinery and offers every conceivable kind of machine, tool or mold necessary for all kinds of concrete work.

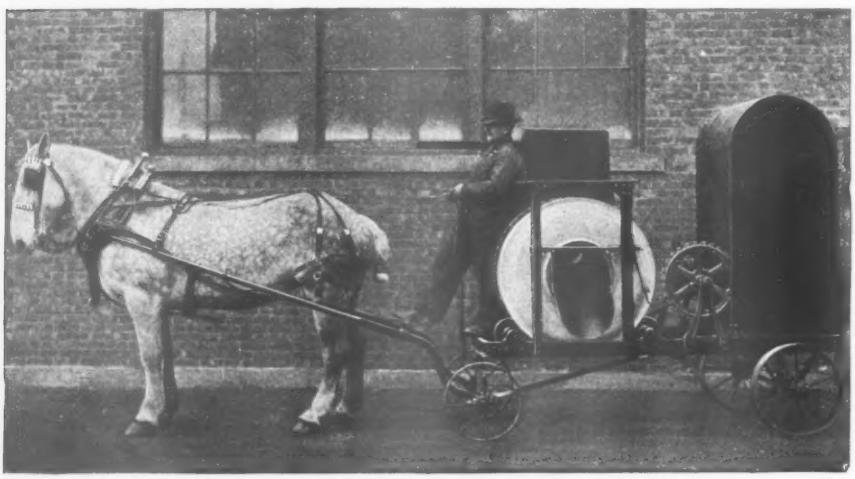
The Miracle line, consisting of concrete machines of single and double staggered air-space, two-piece wall block machines,

brick machines, mixers, tile molds, ornamental molds and molds for cornices, chimneys, piers, burial vaults, etc., is one of the oldest lines in existence.

The Minneapolis plant will be abandoned and all machinery, stock, etc., will be moved to Eau Claire, where the manufacturing will be done in the plant of the Northwestern Steel & Iron Works. This last step was taken because of adequate facilities, added conveniences and more space afforded at the Eau Claire plant.

A Small Portable Concrete Mixer.

A new concrete mixer has been placed on the market by Chain Belt Company to meet the demand for a machine of small capacity, that can be easily moved from place to place with one horse. It is particularly well adapted for the use of contractors who have occasion to do small jobs of sidewalk laying, and for use in the country in building silos, barn floors, troughs, etc.



A SMALL PORTABLE CONCRETE MIXER.

The mixer shown in the accompanying photograph, is called the No. 00, and has the capacity of 4½ cubic feet of loose material, or 3½ cubic feet of mixed materials per batch. It is furnished with gasoline power, being provided with a three-horse power water cooled engine. This machine can also be rigged up with an electric motor. The drum, like those of all Chain Belt mixers, is made entirely of a special mixture of semi-steel, and is cast in two sections.

The mixing is accomplished by means of ¼-inch steel mixing blades and malleable iron buckets in the interior of the drum. On this machine, as with other Chain Belt mixers, gears are conspicuous by their absence, as the drum is driven by steel roller chain belt. The roller track surfaces of the drum and the rollers on which it rests are made of chilled semi-steel and there is the least possible opportunity for the moving parts to wear out.

It is manufactured by the Chain Belt Company, Milwaukee, Wis.

A Detachable Electric Row Boat Motor.

The Jewel electric boat propelling device is attracting the attention of hunters, fishermen, automobilists and pleasure seekers at summer resorts.

This portable device weighs complete twenty-five pounds and can be attached to any canoe or row boat by means of adjustable clamps.

The electrical motor is mounted vertically on a supporting tube and is said to have a maximum speed of 2,500 r. p. m. Two 6-volt 60-ampere hour storage batteries connected in series supply current for the motor. The motor is direct connected to a vertical transmission shaft about two feet above the water line.

The power is transmitted to a pair of special gears somewhat similar to the worm gear type. The circular gears operate in a gear housing below the water line and change the vertical power transmission to the horizontal propeller shaft.

The Jewel detachable row boat motor is manufactured by the Jewel Electric Co., located at 1122 South Michigan avenue, Chicago, Ill.

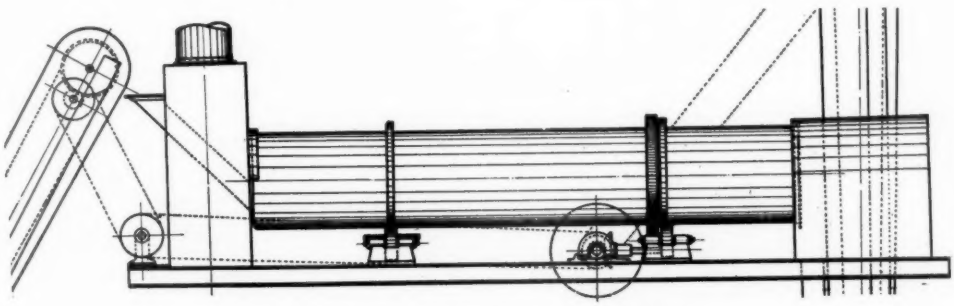
A Correction.

Due to a typographical error, the address of the Des Moines Bridge and Iron Co., which was given on page 419 of the May issue, was stated to be 912 Casey Building. It should have been 912 Curry Building, Pittsburg, Pa.

Portable Dryer.

It is usually found that the ordinary portable sand and stone dryer or heater is difficult to move from point to point on account of excessive weight. The machine shown in the drawing is designed for portable and semi-portable work. It is light and simple in design, yet all parts are made strong and durable, no sacrifice being made in any case to secure lightness at the expense of strength.

The American process direct heat dryer is of the direct heat and direct contact type. It consists essentially of a cylindrical steel shell, provided on the interior with longitudinal shelves. Near each end of the shell is a weldless rolled steel tire which rests on carefully chilled and ground friction wheels. These wheels are rotated by gearing or chain belting, and they in turn impart rotation to the shell. The dryer as a whole is set on a gentle slope, determined and fixed by experience.



THE AMERICAN PROCESS PORTABLE DRYER.

The operation of the machine is simple and thorough. The wet material enters the shell at the higher end, falls to the bottom of the dryer, is caught by a shelf, elevated to almost the highest point of the rotation, and is then showered through the furnace gases. This cycle of operations is repeated until the material, in a dried condition, is discharged from the lower end of the dryer. The motion of the material towards the discharge is because of the slope of the dryer. The material travels in the opposite direction to that of the hot gases in order to bring the highest temperature in contact with the dry material thus heating the material to any temperature required. The driving arrangement for conveyors going to and from the dryer or heater is simple in design and does not require much power.

The manufacturers, the American Process Company, 68 William street, New York City, make a specialty of dryers and have made a study of a type to secure maximum capacity with a minimum amount of fuel and lowest possible cost for repairs. The moving parts are few and so constructed that the wear is small and entirely confined to parts easily repaired or replaced at small cost. The wearing parts are all exposed and can be watched by the operator without taking him from other duties, and it is claimed that the machine is altogether the most economical and inexpensive on the market.

The H. W. Johns-Manville Co. Moves to Larger Quarters.

The executive offices and New York show rooms of the H. W. Johns-Manville Co., manufacturers of asbestos, magnesia and electrical supplies, were moved on April 20, from their old quarters at 100 William street, to the new twelve-story H. W. Johns-Manville building, Madison avenue and Forty-first street, New York City.

This move marks the fifty-fourth anniversary of the company. Under the name of H. W. Johns Manufacturing Co. the business was conducted at 87 Maiden Lane, previous to May 1, 1897, when it was moved to 100 William street. In 1901 the firm name was changed to H. W. Johns-Manville Co., a consolidation being effected between the Manville Covering Co., of Milwaukee, Wis., and H. W. Johns Manufacturing Co. This last combination brought together two of the largest manufacturers of pipe and boiler coverings, packings, roofings, etc., in the world, and the growth of the company since that time has been marked.

They now have factories located in Brooklyn, N. Y., Milwaukee, Wis., West Milwaukee, Wis., Hartford, Conn., Nashua, N. H., Lockport, N. Y., and Newark, N. J., with an asphalt refinery at South Amboy, N. J., and extensive asbestos mines at Danville, in the

Province of Quebec, Canada, which are the largest in existence and produce an exceptionally fine grade of asbestos. They also have a branch house in every city of any size in the United States and Canada, as well as representatives in about all foreign countries.

In the new quarters the company will occupy an entire twelve-story office building. In its entirety the company now occupies over 2,657,160 square feet of floor space, or about 61 acres. The employes number approximately 5,000 and there are about 425 salesmen.

The Matchless Sanitary Street Cleaning Machine.

A recent "municipal parade" in an enterprising western city furnished an object lesson in the lack of efficiency in our street cleaning methods. Following the line of modern street rotary brooms, and flushers, came a straggling line of ordinary boxes on wheels, each containing a shovel, and propelled by one able-bodied workman. Following these came a double number of laborers, each with a flat scoop which he pushed before him as he marched. It was thus demonstrated to the citizens who watched the parade, that it took two men to serve each of these push carts, or three men for each street dirt carrier.

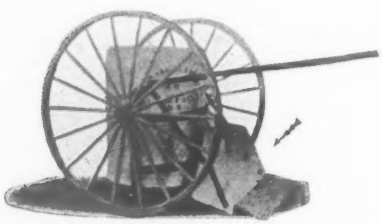
In contrast to this is the Matchless Street Cleaner, manufactured by the Matchless Cleaner Company, Troy, N. Y. In this case only one man is required to quickly and efficiently operate each street cleaning unit. The machine consists of a two-wheeled cart, strongly built of steel throughout, with light wooden wheels. The dust pan, which is the distinctive feature of the machine, is attached to the cart by a revolving arm. The pan is constructed of galvanized iron, with a blade 28 inches long and 6 inches wide, made of spring steel.

The method of using the machine is so simple as to make its efficient use possible, even to the most unskilled labor. The cart is pushed to the part of the street to be cleaned, and the dust pan lowered to rest upon the pavement a short distance beyond the dirt to be gathered. The dirt is then swept by means of a push broom, into the pan which rests in contact with the even surface of the pavement. With the last push of the broom, the brush is left in the pan while the machine is pushed to the next section of pavement to be cleaned. When the dust pan is sufficiently filled, or when it is desired to move the machine for some distance, the mere action of taking the handle of the machine to pull it to its next location, causes the pan to be raised and be emptied into the metal receptacle of the cart.

The Matchless machine dispenses entirely with the use of shovels and scrapers; and the saving of time by its operation is an item which will materially increase the area cleaned by each machine.

An Efficient Weed Killer.

A weed killer to be thoroughly satisfactory for use in parks and cemeteries and on other public work should possess, in addition to its property of destroying vegetation, the elements which render it stainless and non-injurious to stone, metal or woodwork. These attributes are stated to be true of the Key Brand Weed Killer, manufactured by the Interstate Chemical Company, 120 Bayview avenue, Jersey City, N. J.



Sweeping Position.

Dumping Position.

THE MATCHLESS STREET CLEANER.

The preparation is put up in cases and barrels. Before application to the roadway it is mixed with 40 parts of water, and it is spread by means of a sprinkling can or watering cart. The effects of this treatment are said to be much more permanent than the old procedure.

Its use is recommended for the permanent clearing of roadways, paths, streets, gutters, tracks and playgrounds of weeds and grass, for the reason that one application of a gallon for each 25 square feet is said to be effective for several years. It is supplied in barrels, kegs and cans.

Association of American Cement Manufacturers.

The session of the Association of American Portland Cement Manufacturers at the Hotel LaSalle, Chicago, on May 9, was devoted entirely to the subject of good roads and the use of concrete in their construction. The speakers were Logan Waller Page, director Office of Public Roads, Washington, D. C.; Wm. M. Pindell, president Dolarway Paving Co., New York City; W. P. Blair, secretary National Paving Brick Manufacturers Association, Cleveland, Ohio; Edward N. Hines, road commissioner Wayne county, Detroit, Mich., and J. S. McCullough, city engineer, Fond du Lac, Wis.

After the conclusion of the program a special train was chartered and the entire party went to Ann Arbor and Detroit on an inspecting tour of the concrete road work in and near those cities. At Ann Arbor, City Engineer Groves conducted the party on an automobile trip over all the pavements which have been built under his direction. At Detroit, the Wayne county roads were inspected under the guidance of Commissioner Edward N. Hines. In the evening the entire party were the guests of Edward M. Hagar, president of the association, at dinner at the Hotel Pontchartrain.

Trade Publications.

The United States Wood Preserving Company, 71 Broadway, New York City, have prepared a handsomely illustrated booklet devoted entirely to the use of their creosoted wood blocks upon bridges. The roadways and superstructures of about 25 interesting bridges are shown, together with drawings illustrating the use of wood block in bridge flooring.

The April issue of Paving and Roads, issued by the Texas Company, Battery Place, New York City, contains among other articles the following: Extracts from the report of W. W. Crosby to the State Roads Commission of Maryland; Equipment for surfacing roads by the penetration method, by H. Tipper; and the Report of the Association for Standardizing Paving Specifications.

"The Lehigh," published by the Lehigh Portland Cement Co., Peoples Gas Building, Chicago, contains for this month some general material of interest to their distributers, some photographs of the Cleveland Short Line Railway, and the use of cement thereon, and some advertising helps for the dealer.

The Universal Portland Cement Co., Chicago, is publishing a monthly booklet, called the "Permanent Pavement." It is a live publication, which, though frankly devoted to the cause of concrete roads, contains in addition to valuable matter along this line some interesting data which concern the cause of good roads in general. The current issue contains some description of the highway organizations in a number of the states, a discussion of the attitude of railroads toward good roads, and some interesting descriptive matter on concrete pavements.

The Fort Worth Advertising Men's Club prepared a very attractive book of views of the city in anticipation of the visit of The Associated Advertising Clubs of America, which was held on May 22nd.

The Goulds Manufacturing Company, 131 West Fall street, Seneca Falls, N. Y., have issued Bulletin Number 112, devoted to handy data on power pumping. It contains matter relative to pumps, their installation, operation, economy, capacities and rates of suction and discharge; piping, including standard dimensions for wrought iron and light well casing, and a table for equalizing pipes; power, including rules for determining the size and speed of gears, data on shaft transmission, etc.; water, including tables of equivalents, pressure at different heads, friction, discharge, and tables of discharge for nozzles and effective fire streams; and some general information on making estimates for pumping equipment, together with general tables. The Bulletin possesses a great deal of useful information in a very convenient form.

The Universal Portland Cement Co. has issued the fifth edition of the book, "Cement Sidewalks." This is a comprehensive and instructive treatment of the correct methods of laying concrete walks and has been in very wide demand. Copies are sent out by the company free of charge.

Trade Notes.

Birmingham, Ala.—The Birmingham Railway, Light and Power Company plans to place all electric wires under ground at a cost of about $260,000.

San Diego, Cal.—A $75,000 bond issue for playground improvement has been voted. Allen H. Wright, city clerk.

Springfield, Ill.—The purchase of an automobile patrol wagon is contemplated. Chief Underwood.

New York, N. Y.—Dana Pierce, an electrical engineer, has been put in charge of the New York office of the Underwriters' Laboratories as electrical engineer of the Laboratories. He is in position to afford electrical manufacturers through testing stations in both Chicago and New York improved facilities for obtaining opinions and reports upon their products with increased promptness and efficiency.

Akron, O.—Thomas E. Rook has been appointed western sales manager for the American Sewer Pipe Company and will have charge of the territory west of New York and Pennsylvania. Mr. Rook was with the American Steel & Wire Co., and more recently was vice-president and manager of the Cleveland Coal Co., Cleveland, O.

Massillon, O.—The Massillon Iron & Steel Co., has been thoroughly reorganized with ample working capital and is now in full operation, turning out hub and spigot, and flange pipe and fittings as well as a general line of heavy castings and machine work.

IMPROVEMENT AND CONTRACTING NEWS

RMP

ROADS AND PAVEMENTS.

BIDS REQUESTED.

Bedford, Ind.—June 4, 1 p. m. Constructing 6 gravel or macadam roads in Marion, Shawswick, Guthrie and Perry twps. Ezra W. Edwards, audt.

Bloomington, Ind.—June 5, 2 p. m. Constructing stone roads in Bloomington and Washington twp. Horace Blakely, audt.

Bluffton, Ind.—June 6, 10 a. m. Constructing gravel road on line between French and Harrison twps. L. A. Williamson, audt. Wells Co.

Brazil, Ind.—June 7, 11:30 a. m. Constructing limestone road in Brazil twp. Edgar A. Staggs, audt.

Crawfordsville, Ind.—June 4, 10 a. m. Constructing highways in Coal Creek and Union twps. Bennett B. Engle, audt.

Corydon, Ind.—June 5, 2 p. m. Constructing gravel and macadamized roads in Harrison twp. William Taylor, audt.

Frankfort, Ind.—June 6, 2 p. m. Constructing 12 gravel roads. Chas. F. Cromwell, audt.

Huntington, Ind.—June 3, 10 a. m. Constructing a gravel road in Huntington twp. Harold Guthrie, audt.

Indianapolis, Ind.—June 3, 10 a. m. Constructing sidewalks along Fall Creek Parkway. T. L. Lowry, engr., board of park comrs.

Kentland, Ind.—June 3, 2 p. m. Constructing macadamized road in Iroquois rd. E. R. Bringham, audt.

Lafayette, Ind.—June 5, 10 a. m. Constructing 3 gravel rds. Geo. W. Baxter, audt.

Marion, Ind.—June 4, 2 p. m. Constructing highways in Jefferson, Mill, Center, Franklin, Richland and Pleasant twps. E. H. Kimball, audt.

Marion, Ind.—June 13, 2 p. m. Constructing gravel rd. on line between Huntington and Grant counties. E. H. Kimball, audt. of Grant Co.

Newport, Ind.—June 3, 10 a. m. Constructing gravel rds. in Highland twp. H. T. Payne, audt.

Noblesville, Ind.—June 4, 2 p. m. Constructing 2 gravel rds. in Clay twp. Geo. Griffin, audt.

Osgood, Ind.—June 7. Improving Cravens st. and constructing concrete walks. M. F. Hollman, Village prest.

Portland, Ind.—June 3, 10 a. m. Constructing gravel rd. in Jackson twp. John Bonifas, audt.

Richmond, Ind.—June 5, 11 a. m. Improving a highway in Wayne twp. Lewis F. Bowman, audt.

Rushville, Ind.—June 4, 2 p. m. Constructing gravel rds. in Ripley and Center twps. J. M. Stone, audt.

Sullivan, Ind.—June 4, 12 m. Constructing 2 stone rds. in Hadon twp. W. F. Bicknell, audt.

Wabash, Ind.—June 4, 1:30 p. m. Constructing 2 gravel and macadamized rds. in Liberty twp. Daniel Showalter, audt.

Washington, Ind.—June 4, 2 p. m. Constructing 4 gravel rds. Lew S. Fuller, audt.

Winamac, Ind.—June 4, 12 m. Constructing 2 rds. W. E. Munchenberg, audt.

Clinton, Ia.—June 4. Constructing 13,000 sq. yds. of wood block, vitrified brick, sheet asphalt and concrete paving, and 3,750 lin. ft. of curb and gutter. Certified check $1,000. J. B. Throne, city engr.

Waverly, Ia.—June 4. Constructing 34,000 sq. yds. of paving and 16,000 lin. ft. of curb. Bid will be taken on bitulithic, sarcolithic, mineral rubber, Portland cement concrete, asphaltic concrete, Dolarway and brick block. S. A. Lee, city clk.; Ralph B. Slippy, city engr. 401 Marsh-Place Bldg., Waterloo, Ia.

Jackson, Miss.—June 4, 2 p. m. Paving W. Capitol st., S. State st., Hamilton st., with brick, bitulithic, wood block, sheet asphalt, petrolithic, Dolarway, granitoid, or other pavement. Certified check 5 pct. J. S. M'Leod, st. comr.

Albany, N. Y.—June 3, 1 p. m. Road construction as follows: Allegheny co., 6.1 mi.; Broome co., 6.05 and 8.9 mi.; Cayuga co., 11.52 mi.; Chautauqua co., 5.97 mi.; Cattaraugus co., 0.78, 4.52, 1.21 and 2.27 mi.; Dutchess co., 2.97 mi.; Erie co., 3.79 and 1.11 mi.; Franklin co., 2.07 mi.; Greene co., 3.39 mi.; Hamilton co., 6.01 mi.; Jefferson co., 5.31, 11.50 and 1.07; Niagara co., 2.79 and 6.65 mi.; Oneida co., 18.04 mi.; Onondaga co., 4.84, 7.72 and 0.19 mi.; Oswego co., 12.8, 2.79, 3.09 mi.; Rensselaer co., 0.67 mi.; St. Lawrence co., 14.92 mi.; Schenectady co., 4.16 mi.; Tompkins co., 3.10 mi.; Westchester co., 5.22 mi., and Yates co., 1.75 mi. Certified check 5 pct. C. Gordon Reel, supt. of highways; John A. Bensel, state engr.; Duncan W. Peck, supt. of pub. wks.

Albany, N. Y.—June 4, 1 p. m. Road construction as follows: Albany co., 0.43 and 0.46 mi.; Allegheny co., 9.9 mi.; Broome co., 3.15 mi.; Clinton co., 2.24 and 8.25 mi.; Cayuga co., 2.75 mi.; Columbia co., 6.17 mi.; Chautauqua co., 5.53 mi.; Cattaraugus co., 6.74 mi.; Erie co., 2.6 and 1.86 mi.; Greene co., 4.62 and 6.13 mi.; Hamilton co., 7.82 mi.; Jefferson co., 7.32 mi.; Monroe co., 3.43 mi.; Nassau co., 1.24 mi.; Niagara co., 3.16 and 6.81 mi.; Onondaga co., 4.32, 3.31, 1.03 mi.; Orange co., 3.88 mi.; Oswego co., 8.15 and 6.17 mi.; Saratoga co., 7.52 mi.; Seneca co., 4.02 mi.; Sullivan co., 10.95 mi.; Tompkins co., 6.26 mi., and Suffolk co., 12.92 mi. Certified check 5 pct. on each bid. C. Gordon Reel, supt. of highways; John A. Bensel, state engr.

Albany, N. Y.—June 5, 1 p. m. Road construction as follows: Albany co., 4.21 mi.; Broome co., 3.21 mi.; Clinton co., 1.79 mi.; Cayuga co., 1.40 mi.; Chautauqua co., 21.15 mi.; Cattaraugus co., 4.49 mi.; Delaware co., 13.43 mi.; Erie co., 3.49, 3.15 and 4.20 mi.; Franklin co., 5.49 mi.; Jefferson co., 8.45 and 13.39 mi.; Livingston co., 1.25 and 6.32 mi.; Monroe co., 6.63 mi.; Niagara co., 2.52 and 5.13 mi.; Oneida co., 7.78 and 0.83 mi.; Onondaga co., 3.42, 0.49 and 11.11 mi.; Oswego co., 42.25 and 5.23 mi.; Ontario co., 7.37 mi.; Orange co., 5.86 mi.; Orleans co., 4.62 mi.; Putnam co., 6.27 mi.; Rensselaer co., 3.66 mi.; St. Lawrence co., 10.26 and 8.91 mi.; Schenectady co., 1.38 mi.; Warren co., 3.53 mi. Certified check 5 pct. on each bid. C. Gordon Reel, supt. of highways; J. A. Bensel, state highway engineer.

Albany, N. Y.—June 6, 1 p. m. Road con-

struction as follows: Cortland co., 0.87 mi.; Chenango co., 5.16, 4.73 mi.; Chemung co., 5.47 and 4.37 mi.; Essex co., 2.13 and 3.69 mi.; Lewis co., 1.31 mi.; Livingston co., 2.12, 4.26 and 2.92 mi.; Madison co., 0.43 and 4.23 mi.; Onondaga co., 4.24, 7.59, 6.08 and 10.48 mi.; Oswego co., 6.37 and 5.72 mi.; Saratoga co., 1.03 and 1.75 mi.; Steuben co., 3.90 mi.; St. Lawrence co., 5.99, 5.37, 4.58 and 1.0 mi.; Schuyler co., 6.56 and 5.15 mi.; Suffolk co., 3.88 mi.; Tompkins co., 6.67 and 1.17 mi.; Tioga co., 3.65 mi.; Westchester co., 7.34, 7.07 mi.; Washington co., 6.01 mi.; Tioga and Broome cos., 10.72 mi. Certified check 5 pct. C. Gordon Reel, supt. of highways; John A. Bensel, state highway engineer.

Albany, N. Y.—June 7, 1 p. m. Road construction as follows: Chenango co., 3.0, 3.81 and 2.33 mi.; Chemung co., 12.39 mi.; Delaware co., 13.37 mi.; Essex co., 2.19, 2.21 and 6.06 mi.; Clinton co., 4.97 mi.; Fulton co., 1.01 mi.; Lewis co., 4.60 mi.; Livingston co., 7.21, 5.51, 3.43 mi.; Madison co., 5.09 mi.; Montgomery co., 6.20 mi.; Niagara co., 7.95 mi.; Otsego co., 12.21 mi.; Rockland co., 4.47 mi.; Seneca co., 6.88 mi.; Steuben co., 3.92 and 17.19 mi.; St. Lawrence co., 11.66, 2.51, 4.09, 4.08 and 6.56 mi.; Suffolk co., 11.25, 1.32 and 1.04 mi.; Sullivan co., 8.51 and 1.37 mi.; Tioga co., 9.83 mi.; Wayne co., 7.0 mi.; Wyoming co., 3.52 mi, and Rensselaer co., 0.51, 0.95 and 1.58 mi. Certified check 5 pct. C. Gordon Reel, supt. of highways; John A. Bensel, state engineer.

Cleveland Heights, O.—June 18, 12 m. Furnishing material and oiling a number of rds. in and around the village. H. H. Canfield, city clk.; The F. A. Pease Engr. Co., 931 Williamson bldg., Cleveland, O., engrs.

Columbus, O.—June 4, 2 p. m. Road construction as follows: Engrs. est. No. 378, macadamizing the Gibson-Snouffer rd. in Perry twp.; certified check, $200; engrs. est. No. 379, including Harrisburg and Georgesville rd. in Pleasant twp.; certified check, $500; engrs. est. No. 382, including the Columbus and Westerville rd. in Blendon twp.; certified check, $500. John Scott, clk. bd. of Franklin co. comrs.

Norwalk, O.—June 5, 1 p. m. Road construction as follows: I mi. of concrete roadway on the Fairfield rd.; 1¼ mi. of macadam roadway on the Old State rd. Certified check, $300, on each bid. A. E. Ward, clk. of Bronson twp.

Steinersville, O.—June 4. Macadamizing 2.4 mi. or rd. in York twp. G. L. Bonar, clk., Powhattan Point, O.

Steubenville, O.—June 14. Constructing the Bantam Ridge rd. in Jefferson co. O. J. M. Thompson, chr. rd. comrs.

Pittsburgh, Pa.—June 13, 10 a. m. Constructing Versailles extension and the Briston rd. Certified check $100 on each bid. R. G. Cunningham, co. audt.

Davenport, Wash.—June 7, 1:30 p. m. Surfacing roadway and constructing 16,583 ft. of permanent highway in Lincoln co. J. W. Brislawn, clk. bd. co. comrs.

Wenatchee, Wash.—June 6, 10 a. m. Constructing permanent highways Nos. 2 and 3, the first, 6,560 ft., and the second, 11,824 ft. T. S. Gellatly, audt. of Chelan co.

CONTRACTS AWARDED.

Los Angeles, Cal.—Paving Alvarado st. with vitrified brick, to the Fairchild-Gilmore-Wilton Co., Los Angeles, Cal., $36,997.

Hartford, Conn.—Macadamizing 2,256 ft. on Lincoln st., to the Pierson Engr. Co., Bristol, Conn.

Aurora, Ill.—Paving 7 East Side sts., to the McCarthy Improvement Co., Davenport, Ia.

Bement, Ill.—Paving Bodman st., to Wm. F. Lodge and James P. Lodge, Monticello, Ill., $16,634.

Freeport, Ill.—Paving Iroquois st., to the Gund-Graham Co., Freeport, Ill., $10,001.

Brazil, Ind.—Constructing the R. L. Kennedy rd., to Hawkins Bros., $13,163.

Greensburg, Ind.—Constructing macadam road in Sandcreek twp., to Ralph Davis, Greensburg, $12,420.

Hartford City, Ind.—The following road contracts have been awarded: Constructing the Blair rd., to Geo. Saunders, Muncie, Ind., $6,728; constructing the Fleming-Futrell rd., to S. T. Williams, Hartford City, Ind., $12,-850.

Terre Haute, Ind.—Constructing the Haynes gravel rd., in Nevin twp., to Hawkins Bros., Brazil, Ind., $13,739; constructing the Trueblood rd., in Nevin twp., to Wood & Vangilder, $9,960.

Mason City, Ia.—Constructing 45,000 sq. yds. of concrete pavement, to Geo. Gabler, Mason City, Ia.

Rock Island, Ill.—The following paving contracts have been awarded: 2nd ave., repaving, to the McCarthy Improvement Co., $25,900; 4th ave., to the Independent Construction Co., about $10,000; 6th ave., to the McCarthy Improvement Co., $3,804.

Manhattan, Kan.—Paving Bluemont ave., to Peak & Stingley, Manhattan, Kan.

Pittsburg, Kan.—Paving Jefferson ave., to Thogmartin & Gardiner, Ft. Scott, Kan.

Shreveport, La.—Paving Cedar and Laurel sts., to the Southern Bitulithic Co.

Baltimore, Md.—The following paving contracts have been awarded: Vitrified brick, to the Cunningham Paving & Construction Co., Baltimore, Md., $35,998; wood block paving, to the United States Wood Preserving Co., 165 Broadway, New York City.

Boston, Mass.—The following paving contracts have been awarded: For wood block pavement in Hammont st., to the Fred S. & A. D. Gore Corp., $17,831; for wood block pavement in Massachusetts ave., to the Fred S. & A. D. Gore Corp., $32,179.

Boston, Mass.—The following paving contracts have been awarded: Washington st., with wood block, to William J. Barry, $105,-299; Massachusetts ave., with wood block, to the Fred S. & A. D. Gore Corp., $32,179; Hammond st., with wood block, to the A. G. Coleman & Sons Co., $18,782.

Luverne, Minn.—Constructing 4½ mi. of state rd. No. 1, to Henry Enke, Lake Wilson, Minn.

St. Louis, Mo.—The following street improvement contracts have been awarded by the board of local improvement: Improving John st. with brick, to John McMahon, $2,244; improving Gasconade st. with brick, to Eyerman Construction Co., $3,174; improving Grace ave. with brick, to Eyerman Construction Co., $8,072; improving Newhouse ave. with brick, to John McMahon, $3,357; improving Shaw ave. with brick, to Eyerman Construction Co., $26,365. Reconstructing Arsenal st. with brick, to Eyerman Construction Co., $7,726; reconstructing Cherokee st. with brick, to Eyerman Construction Co., $3,701; reconstructing Mound st. with brick, to John McMahon, $3,413; reconstructing N. Market st. with brick, to John McMahon, $31,-588. Improving Delmar bvd. with wood block, to Harry F. Heman, $7,732; improving Delmar bvd. with wood block, to Granite Bituminous Paving Co., $15,112. Reconstructing Locust st. with wood block, to Eyerman Construction Co., $16,748; reconstructing Olive st., to Eyerman Construction Co., $8,678.

Helena, Mont.—The following paving contracts have been awarded: Helena ave. with brick, to Smith & Saner, $14,344; Railroad st. with brick, to Louis Johnson, $22,332; Davis st., to Louis Johnson, $4,439.

Helena, Mont.—Paving construction in the 9th ave. improvement district, to the Miracle-Tripp Concrete Co., $24,811.

Missoula, Mont.—Paving a number of sts. with brick, to Geo. Dietrich, Seattle, Wash., $58,728.

Albany, N. Y.—The following extensive road contracts have been awarded. Albany city line to Watervliet with brick, distance 2.45 mi., to John B. Dover, Ballston Spa., $61,125; East Berne to Glyckmans Church,

4.36 mi., to Ruddy & Saunders Construction Co., Troy, $41,215, and Feura Bush to Indian Fields, 8.27 mi., to Herlihy Constructing Co., Glens Falls, $81,406. Rensselaer County—Speigletown to Melrose, 2.55 mi., to Coriiss Construction Co., Troy, $26,720; De Freestville to Couse, 3.14 mi., to Arnold & Shearer, Albany, $34,471; 0.41 mi. in Nassau village, to County Construction Co., Troy, $5,606; Cropseyville to Grafton, 5.93 mi., to Snead & Wilson, Brown's Sta., $68,799; Wyantskill to DeFreestville, 4.10 mi., to William Paterson, Albany, $33,362, and 0.29 mi. in Nassau village, to the County Construction Co., Troy, $4,083. Greene County—Cairo hamlet, 0.46 mi., to Catskill Supply Co., Catskill, $5,197; Saugerties to Catskill, 3.87 mi., to Rosseau & Parker, Hudson, $46,582, and Hunter to Winham, 6.27 mi., to S. B. Van Wagenen, Rondout, $74,555. Washington County—Hudson Falls to Fort Ann, 8.23 mi., to James Anderson, Albany, $63,362. Clinton County—1.28 mi. in Battleman, to Spellman-Oliver Co., Chateaugay, $15,498. Otsego County—1.93 mi. in Unadilla village, to Hollington Co., Troy, $39,427. Saratoga County—Stillwell to Schuylerville, 5.38 mi., to W. G. Fox, Saratoga Springs, $60,538.

Canton, O.—Paving the Louisville rd. for a distance of 2½ mi., to W. H. Voght & Son, Massillon, O.

Cambridge, O.—Constructing 2 mi. of rd., to Adams Bros., Zanesville, O., $16,000.

Girard, O.—Paving and constructing storm water sewers on State st., to Turner & Olsen, Youngstown, O., $84,224.

Youngstown, O.—The following paving contracts have been awarded: Mt. Pleasant st. to James McCarren, $17,276; Earle ave., to Kennedy Bros., $12,474; Erie st., to A. Serafino, $4,971; Garland ave., to Turner & Olson, $1,007.

Hillsboro, Ore.—Constructing asphalt macadam and asphalt pavement, to the Barber Paving Co., $118,000.

Portland, Ore.—Constructing 2 mi. of Warrenite pavement, to Warren Bros. Co.

Salem, Ore.—Constructing ½ mi. of Dolarway concrete paving, to the W. Geiger Contracting Co., Salem, Ore.

Pittsburgh, Pa.—The following extensive paving contracts have been awarded by the board of public works, Joseph G. Armstrong, director: Repaving with blockstone, Penn ave., to H. C. Howard, $27,821; Selby ave., to Thomas Cronin Co., $6,848; W. Carson st., to Booth & Flinn, $2,195; Wilkins ave., to Thomas Cronin Co., $8,747; Liberty ave., to H. C. Howard, $8,582. Repaving with wood block, Sandusky st., to M. O'Herron Co., $2,156; Ohio st., to H. C. Howard, $16,373; repaving with brick, Pretense alley, to J. H. Sheets, $1,340. Repaving with asphalt, Penn ave., to Booth & Flinn, $8,837; 5th ave., to Booth & Flinn, $21,646; Perrysville ave., to Booth & Flinn, $18,462. Grading, paving and curbing with brick, Loretta st., to M. O'Herron Co., $9,749. Grading, paving and curbing with blockstone, Merriman alley, to Thomas Cronin Co., $1,967.

Chattanooga, Tenn.—The paving of Glass st., to G. L. Coffey & Co., Chattanooga, Tenn., $17,100.

Dallas, Tex.—Paving Exposition ave., to the Roach-Maning Paving Co., Fort Worth, Tex., $56,157.

Cashmere, Wash.—Constructing concrete sidewalks and curbing, to C. H. Payne, Spokane, Wash., $17,605.

Bellingham, Wash.—Paving 15th st., to Peterson, Wevel & Hawkins, $15,229.

Olympia, Wash.—Paving E. 4th st. with asphalt, to W. A. Weler, Olympia, Wash., $32,471.

Seattle, Wash.—The following road improvement contracts have been awarded: Replanking Railroad ave., to J. A. McEachern Co., Bailey bldg., Seattle, Wash., $22,970; grading 42nd ave., S., to Marx, Russell & Gallagher, Bailey bldg., Seattle, Wash., $15,210.

South Bend, Wash.—The following paving contracts have been awarded: Bitulithic paving, to the Barber Asphalt Paving Co., $15,658; regrading the Water st. hill, to the Jahn Construction Co., Seattle, Wash., $13,605.

Tacoma, Wash.—Paving the Point Defiance Park rd., to Joseph Warder, Tacoma, Wash., $19,525.

Walla Walla, Wash.—Constructing pavement in 10 to 12 alleys, to Tribou Blackman, Walla Walla, Wash., $10,344.

Wheeling, W. Va.—The paving of S. McCullough st., from Baker st. to 12th st. with brick paving on concrete foundation, to Coss & Meyer, $15,340.

CONTEMPLATED WORK.

Fort Smith, Ark.—The construction of 200,000 sq. yds. of paving in the original paving district is contemplated.

Marysville, Cal.—The paving of 4th and 5th sts., to cost about $25,000, is contemplated.

Carrollton, Ga.—A $10,000 bond issue for street improvement has been voted.

Fitzgerald, Ga.—A $120,000 bond issue for paving improvement has been voted.

Burnham, Ill.—A $10,000 bond issue for paving construction has been voted.

Carlyle, Ill.—The paving of about 2 mi. of streets is contemplated for the early fall. Ben Bond, secy. bd. of loc. imp.; F. A. Lietze, engr.; H. G. Webber, special counsel.

Freeport, Ill.—The improvement of Taylor ave. and Hendrickson st. for the construction of a storm sewer and brick paving on a concrete foundation, to cost about $35,000, is contemplated. City Engr. Hepner has prepared plans and estimates.

Pontiac, Ill.—The construction of 29 blocks or about 1½ mi. of brick paving on concrete base is contemplated. T. B. Knight, city engr.

Bluffton, Ind.—The co. comrs. have signed bonds for 20 gravel and stone rds. in Wells co., the estimated cost of which is $84,140.

Marion, Kan.—H. A. Rowland, McPherson, Kan., has been retained to prepare plans and specifications for 15,000 yds. of paving.

McPherson, Kan.—The city council has passed resolutions for paving 10 blocks of sts., to be completed this summer. H. A. Rowland, city engr.

Wichita, Kan.—City Engr. Bert C. Wells has prepared estimates on paving to cost about $59,000.

Pineville, Ky.—A $600,000 bond issue for road construction has been voted by Bell co.

Bad Axe, Mich.—An $18,000 bond issue for road construction has been voted by Sheridan twp.

Oxford, Miss.—Lafayette co. has voted $200,000 bond issue for road construction.

Warrensburg, Mo.—A $40,000 bond issue for street improvement and sewer construction has been voted.

Hickory, N. C.—A $50,000 bond issue for road construction has been voted by Catawba co.

Montclair, N. J.—The paving of Orange rd. and Upper Mountain ave., to cost $195,000, is contemplated.

Ventnor City, N. J.—A $25,000 bond issue for street improvement has been voted.

Au Sable Forks, N. Y.—A $10,000 bond issue for road construction has been voted.

Buffalo, N. Y.—The supervisors have provided $110,000 for their portion, 35 per cent., on the following roads to be improved: Glenwood-Holland, 3.14 miles, estimated cost $67,500; Sand Hill road, 1.11 miles, estimated cost $53,900; Water Valley-Clarksburg road, 2.89 miles, estimated cost $49,000; Chaffee-Farginia road, 4.2 miles, estimated cost $60,400; the Tonawanda Creek road, 3.77 miles, estimated cost $84,500.

Frankfort, N. Y.—A $24,000 bond issue for road construction has been voted. George K. Nite, town clerk.

Medina, N. Y.—A $15,000 bond issue for road construction has been voted.

Newcastle, N. Y.—(Mt. Kisco P. O.)—A

$135,800 bond issue for road construction has been voted.

Rye, N. Y.—A $33,000 bond issue for improvement of the Boston Post road has been voted. A $30,000 bond issue for street improvement in the village was also voted. George L. Henderson, village clerk.

Stillwater, N. Y.—A $16,000 bond issue to provide funds for the paving of Main street has been voted.

Watkins, N. Y.—A $37,500 bond issue for pavement construction has been voted. Raymond Hoare, village clerk.

Westfield, N. Y.—A $26,000 bond issue for paving North Portage street with brick has been voted.

Newton, N. C.—A $50,000 bond issue for road construction has been voted. W. C. Gaither, town attorney.

Roseburg, Ore.—The paving of North Roseburg street with concrete, to cost about $39,000, is contemplated.

Dale, Pa.—A $25,000 bond issue for paving construction has been voted.

Munhall, Pa.—A $15,000 bond issue for street improvement has been voted.

Dethan, S. D.—The construction of a complete waterworks system is contemplated. Money is available for immediate construction.

Livingston, Tenn.—A $150,000 bond issue for road construction has been voted by Overton county.

Austin, Tex.—A $250,000 bond issue for street improvement has been voted.

Bastrop, Tex.—An $80,000 bond issue for road construction has been voted.

Kerrville, Tex.—A $20,000 bond issue for street improvement has been voted.

Terrell, Tex.—Bids will be requested soon for 20,000 sq. yds. of pavement. W. Irving Bean, acting city engineer.

Washburn, Tex.—Bayfield county has voted a $50,000 bond issue for road construction.

Tacoma, Wash.—The city is contemplating the installation of an asphalt paving plant. It has been suggested that the city and county join in the purchase of such a plant.

Chatham, Va.—A $20,000 bond issue for street paving has been voted.

Stafford, Va.—A $100,000 bond issue for road construction has been voted.

SEWERS.

BIDS REQUESTED.

Reinbeck, Ia.—June 4. All bids for the construction of a sanitary sewer system and extensions to the water works system were rejected on May 13 and will be let at the date above noted. R. D. Ferguson, town clerk. Iowa Engineering Company, Clinton, Ia., engineers.

Grandview Heights, O.—June 17, 12 m. Laying water mains on Grandview avenue and First avenue. Constructing sewers on Grandview avenue and First avenue. Certified check $1,000. John Hinterschied, clerk.

Newburgh, O.—June 15, 12 m. Constructing sewers and water mains on 15 sections of street. Certified check $200. J. M. Shimek, clk.

CONTRACTS AWARDED.

Torrante, Cal.—Constructing sewage disposal plant, to Bent & Pennebaker, $50,000.

Bridgeport, Conn.—Constructing sewers, to the Pierce Manufacturing Company, $20,000.

South Bend, Ind.—Constructing four sewers, to L. H. Wedster, and two sewers, to Henry De Voss and Dedaette & Cousens.

Boise, Idaho.—Constructing the main sewer in District No. 2, to the Idaho Hardware and Plumbing Company, Boise, Idaho, $25,063.

Des Moines, Ia.—Constructing the Greenwood Park sewer system to the J. W. Turner Improvement Company, $23,700; constructing 44th and Center street sewer system, to T. J. Casselbury, $1,118.

Knoxville, Ia.—Constructing two miles of sewer, Hoar-Partington, Iowa City, Ia., $32,827.

Mankato, Minn.—Constructing a complete sewer system, to Lars Overn, St. Peter, Minn., $10,221.

Newark, N. Y.—Constructing complete sewerage system and a siphon, to Stephen Flanagan & Son Construction Company, Scranton, Pa., $67,403.

Charlotte, N. C.—Constructing nine miles of sewer, to Dabbs & Myers, Meridian, Miss., $37,884.

Girard, O.—Paving and constructing storm water sewers on State street, to Turner & Olsen, Youngstown, O., $84,224.

Portland, Ore.—The following sewer contracts have been awarded: Trunk sewer No. 1, to Gibbisch & Joplin, $66,202; trunk sewer No. 2, to K. Fauset, $72,271.

Cresson, Pa.—Constructing sewage disposal plant for the State Sanitarium, to Julian M. Solomin, Philadelphia, Pa., $15,734.

Everson, Pa.—Constructing 16,000 feet of sewer, to "Bud" Sike, $10,568.

Milbank, S. D.—Constructing 10,000 feet of sewer on Thompson street, to Lars Overn, St. Peter, S. D.

Cashmere, Wash.—Constructing a sewerage system, to the Jahn Construction Company, Seattle, Wash., $11,507.

Seattle, Wash.—Constructing sewers in Second avenue N. E., to Clark & Colasurdo, Seattle, Wash., $19,577.

Seattle, Wash.—Constructing sewer on Tenth street, North, to Clark & Colasurdo, Seattle, Wash., $19,577.

CONTEMPLATED WORK.

Jasper, Ala.—A $15,000 bond issue for a sewer system has been voted.

San Diego, Cal.—A $120,000 bond issue for sewer improvement has been voted. Allen H. Wright, cy. clk.

Fort Meade, Fla.—A $20,000 bond issue for sewer construction has been voted. W. E. Arthur, chairman Board of Bond Trustees.

Carrollton, Ga.—A $9,000 bond issue for sewerage construction has been voted.

Weiser, Idaho.—The construction of about eight miles of sewer, to cost about $70,000, is contemplated. R. J. Wood, city engineer.

Carlyle, Ill.—Assessment rolls are being prepared for a vitrified clay pipe sewer system to cost $18,067. Ben Bond, secretary Board of Local Improvements; F. A. Dietze, engineer, and H. G. Webber, special counsel.

Elgin, Ill.—The construction of a sewer to Thomas Cronin Co., $1,600; S. 25th st., on West Chicago street, to cost $78,500, is contemplated.

Wood River, Ill.—The construction of a sewerage system, estimated cost $27,320, is contemplated.

Creston, Ia.—The construction of sewers in District No. 1, including 3,000 feet 18-inch, 1,500 feet 6-inch and 100 Y's, is contemplated. J. F. Golden, city clerk; T. S. Delay, Creston, Ia., engineer.

Wichita, Kas.—The construction of a sewer on Third street, to cost about $33,000, is contemplated. Bert C. Wells, city engineer.

Sturgis, Mich.—A $57,000 bond issue for sewer construction has ben voted. E. Nicholson, city engineer.

Hibbing, Minn.—The city engineer has been instructed to prepare plans and estimates for the construction of sewers amounting to $76,000.

Warrensburg, Mo.—A $40,000 bond issue for street improvement and sewer construction has been voted.

Longport, N. J.—A $14,000 bond issue for sewer construction has been voted. Ralph Havarul, myr.

Buffalo, N. Y.—The construction of an 8-foot brick sewer in Swan and Seneca

streets is contemplated. A $50,000 bond issue has been ordered.

Monroe, N. C.—A $30,000 bond issue for sewer construction has been voted.

Bexley (Columbus P. O.), O.—A $90,000 bond issue for the installation of a sewerage and a water works system has been voted.

Geneva, O.—Cumings & Downer, Painesville, O., have been retained to prepare plans and estimates for a complete sewer system on Eastwood and East Main streets.

East Mauch Chunk, Pa.—The construction of a sewer system to cost about $35,000 is contemplated.

Ligonier, Pa.—A $65,000 bond issue for the construction of a sewage disposal plant has been voted.

New Kensington, Pa.—The erection of sewage disposal plant to cost about $40,000.

Austin, Tex.—A $250,000 bond issue for sewer construction has been voted.

Chase City, Va.—A $45,000 bond issue for the construction of a sewerage system has been voted. M. J. Gregory, town clerk.

Bellingham, Wash.—The City Council has authorized the purchase of two automobile fire trucks to cost $12,000.

Spokane, Wash.—City Engineer McCartney has prepared plans and estimates for an intercepting sewer to cost about $215,000.

Fond du Lac, Wis.—A committee of the City Council has been appointed to investigate different systems of sewage disposal with a view to recommending a type of plant to be built by the city. J. S. McCullough, city engineer.

WATER WORKS.

BIDS REQUESTED.

Fort Huachuca, Ariz.—June 12, 10 a. m. Constructing eight and one-half miles of 8-inch steel water pipe. J. L. Jordan, captain and quartermaster, U. S. A.

Shelby, Mont.—June 10, 7 p. m. Constructing water works system complete. Formerly advertised to be let on May 28. City clerk.

Grandview Heights, O.—June 17, 12 m. Laying water mains on Grandview avenue and First avenue. Constructing sewers on Grandview avenue and First avenue. Certified check $1,000. John Hinterschied, clerk.

Newburgh, O.—June 15, 12 m. Constructing sewers and water mains on 15 sections of street. Certified check $200. J. W. Shimek, clk.

CONTRACTS AWARDED.

Colton, Cal.—Laying 10-inch water main on Eighth street, to the O. L. Emery Co.

Lyndon, Kas.—The following water works

Boston, Mass.—The following water works contracts have been awarded: Laying water pipes in Sumner, Princeton and Trenton, to Lewis Balboni Co., $1,568; for laying water pipes with flexible joints in Boston Harbor, to John H. Gerrish, $15,754.

contracts have been awarded: Construction work, to Commercial Construction Company, Kansas City, Mo.; furnishing tank and tower, to the Tank and Tower Company, Memphis, Tenn.; furnishing filtration equipment, to the Pittsburgh Filter Company, Pittsburgh, Pa.; hydrants, valves and pumps, to the English Tool and Supply Company, Kansas City, Mo. Total cost, $27,471. J. W. Mavilty, engineer.

Carlton, Ore.—Constructing complete water works system, to James Kennedy Construction Company, Portland, Ore.

Sutherlin, Ore.—Constructing a complete city water works plant, to Bunnton & Jeffery, Portland, Ore., $14,500.

Mitchell, S. D.—Laying 10,549 feet of water mains, to E. L. Dimick, Laurel, Neb., $9,896.

Nashville, Tenn.—Constructing 30,651 feet of 6-inch water main, to William Leftwich & Co., Nashville, Tenn.

Seattle, Wash.—Laying water mains on Eighteenth avenue, South, to the Jahn Construction Company, Leary building, $28,693.

CONTEMPLATED WORK.

Stevenson, Ala.—A $14,500 bond issue for water works construction has been voted. C. E. Howser, chairman Board of Commissioners.

Springdale, Ark.—Plans are being prepared by Winters & Dove, Ft. Smith, Ark., for the construction of a complete water works system.

San Diego, Cal.—A $340,000 bond issue for water works extensions has been voted. Allen H. Wright, cy. clk.

Oak Creek, Colo.—The construction of a municipal water works plant to cost $30,000 is contemplated.

Fort Meade, Fla.—A $19,000 bond issue for the construction of a water works system has been voted. W. E. Arthur, chairman Board of Bond Trustees.

Weiser, Idaho.—The construction of ten miles of water mains to cost about $90,000 is contemplated. R. J. Wood, city engineer.

Joliet, Ill.—A $35,000 bond issue for water extension has been voted. M. Berscheid, city clerk.

Wood River, Ill.—The construction of a water works system estimated to cost $28,356 is contemplated.

Red Lake Falls, Minn.—A $25,000 bond issue for water works improvement has been voted. Joseph Perrault, city clerk.

Raton, N. M.—Hiram Phillips, St. Louis, Mo., is preparing plans and estimates for a water works system to cost about $400,000. A bond issue has been voted. Floyd Hanes, city clerk.

Grand Forks, N. D.—A $25,000 bond issue for water works construction has been voted.

Bexley (Columbus P. O.), O.—A $90,000 bond issue for water works and sewerage construction has been voted.

Clatskanie, Ore.—A $30,000 bond issue for water works improvement has been voted.

Barnwell, S. C.—A $22,000 bond issue for the construction of an electric light and water works plant has been voted.

St. George, S. C.—A $20,000 bond issue for water works has been voted.

Yankton, S. D.—A $60,000 bond issue for water works improvement has been voted.

Palacios, Tex.—A $25,000 bond issue for water works construction has been voted. W. B. Willis, cy. secy.

Henrietta, Tex.—An $18,000 bond issue for water works construction has been voted.

Sherman, Tex.—A $33,000 bond issue for water works improvement has been voted. B. Kreader, city secretary.

Waco, Tex.—A $400,000 bond issue for the construction of a water filtration plant has been voted.

Clifton Forge, Va.—A $190,000 bond issue for water plant has been voted.

Bremerton, Wash.—A $150,000 bond issue has been voted for the purchase of the plant of the Bremerton Water and Power Company. E. J. McCall, city clerk.

Centralia, Wash.—A $250,000 bond issue for the construction of a gravity water system has been voted.

Chehalis, Wash.—A $115,000 bond issue for a special water supply and a $70,000 bond issue for a gravity water system has been voted. S. J. Allen, city treasurer.

Chinook, Wash.—A franchise has been granted to Lars Birdsdik to install and operate a water works system. A plant will be constructed about July 1.

Grafton, W. Va.—A $90,000 bond issue for water works improvement has been voted.

Huntington, W. Va.—The citizens have voted to construct a new municipal water works system with a capacity for 100,000 population, and to cost about $800,000.

Chilliwack, B. C., Can.—A $144,000 bond issue has been voted for the purchase of the Elk Creek Water Works Company.

BRIDGES.

BIDS REQUESTED.

Twin Falls, Idaho.—June 17, 10 a. m. Constructing two steel bridges across Rock Creek canyon. Certified check, 10 per cent. on each bid. O. G. Zuck, chairman Board of County Commissioners; E. J. Finck, clerk.

Monticello, Ind.—June 18, 12 m. Constructing thirty-three bridges. A. G. Fisher, auditor.

Rushville, Ind.—June 4, 2 p. m. Constructing several bridges. J. M. Stone, auditor.

Frankfort, Ky.—June 6, 12 m. Constructing a two-pier bridge across the Flat creek. Bids to include both steel and concrete structure. R. G. Hieatt, judge of the fiscal Franklin county.

Cleveland, O.—June 15. Constructing concrete bridge on the Cady rd. under Report No. 2940, and concrete culverts on the Drake rd. under Report No. 2945. Jno. S. Goldenbogen, clk.

Cleveland, O.—June 19, 11 a. m. Bridge construction as follows: Report No. 2934, culverts; Report No. 3925, abutments on Canal road; Report No. 2937, steel bridge on Canal road. Certified check 10 per cent. John F. Goldenbogen, clerk of Cuyahoga county.

Jefferson, O.—June 3, 1 p. m. Constructing fill, approach to bridge, as noted in Bulletin of May 11. A. V. Hillyer, clerk of Ashtabula county.

Norwalk, O.—June 5, 1:30 p. m. Constructing concrete roadways on the Townsend and the Fairfield roads. Certified check $100 on each bid. J. M. Bechtol, township clerk.

Bedford, Pa.—June 3, 12 m. Constructing steel superstructure and concrete substructure for single-span bridge over Dry run. Certified check $1,000 on superstructure and $500 on substructure. George R. Shuck, clerk.

Clearfield, Pa.—June 7. Constructing an 80-foot span through plate girder highway bridge over Moxhannon creek. Certified check $500. Jacob Woodring and B. A. Grove, commissioners of Centre county.

Strousberg, Pa.—June 3, 12 m. Constructing one double-arch masonry bridge over McMichaels creek, in Monroe county. Certified check $500. R. C. Evans, clerk county commissioners.

Ritzville, Wash.—June 6. Constructing six county bridges. A. F. Rosenoss, clerk of county commissioners.

CONTRACTS AWARDED.

Ventura, Cal.—Constructing the Sisar and Santa Paula bridges, to F. M. Kearns.

Tampa, Fla.—Constructing steel bridge on Lafayette street, to the Edwards Construction Company, Tampa, Fla.

Julietta, Idaho.—Constructing a 70-foot steel bridge east of Juliaetta, to the Security Bridge Company, Lewiston, Idaho.

New Lenox, Ill.—Constructing concrete bridge, to the Joliet Bridge and Iron Company, Joliet, Ill.

East Chicago, Ind.—Constructing a bridge at Forsyth avenue, to Geo. Owens Reed, Michigan City, Ind.

Newcastle, Ind.—Constructing bridge in Decatur county, to the Pan-American Bridge Company.

Richmond, Ind.—Constructing four steel bridges, Isaac E. Smith, Richmond, Ind.

Creston, Ia.—Constructing reinforced concrete deck girder bridge in Union county, to Kimballton Construction Company, Atlantic, Ia., $16,037.

Rock Rapids, Ia.—Constructing bridges in Lyon county during 1912, to Western Bridge and Construction Company, Omaha, Neb.

Lewistown, Mont.—Constructing a bridge across Cottonwood creek and bridge over Warm Springs creek, to the Security Bridge Company, Minneapolis, Minn.

Fulton, N. Y.—Constructing a concrete arch bridge over the Barge canal, to R. D. Murdock, Crown Point, N. Y.

Hendersonville, N. C.—Constructing two steel bridges across the French Broad river, to the Roanoke Bridge Company, Roanoke, Virginia.

Buffalo, N. Y.—Bids for the construction of the new bascule bridge across the Black Rock Harbor, at Ferry st., have been opened by Col. J. E. Warren. The Great Lakes Dredge & Dock Co., Chicago, Ill., were the low bidders, at $126,871.

Dayton, O.—Constructing the Herman Avenue bridge, to G. K. Cetone, Dayton, O.

Jefferson, O.—Constructing a bridge over Hubbard's run, to B. F. Hewitt, Jefferson, O.

Marietta, O.—Constructing the Browns run bridge, to the Caldwell Mining Car and Foundry Company, Caldwell, O.

Mt. Gilead, O.—Constructing the Anchor Mill bridge, to the Hackadorn Construction Company, Indianapolis, Ind.

Pawnee, Okla.—Constructing five steel bridges, to the Canton Bridge Company, and two bridges, to T. E. Myers, Pawnee, Okla.

Astoria, Ore.—Constructing steel bridge over Big creek near Knappa, to the Portland Bridge and Iron Company, Portland, Ore.

Rapid City, S. D.—Constructing two bridges across the Cheyenne river, to the Hennepin Bridge Company, Minneapolis, Minn.

Colfax, Wash.—Constructing bridge across Hangman creek, to O. H. Stratton, Spokane, Wash., $6,200; constructing the Union Flat steel bridge, to the same, $2,180.

Everett, Wash.—Constructing bridge on Third street, to the Everett Construction Company, Everett, Wash.

Olympia, Wash.—The following bridge contracts have been awarded by the State Highway Commission: The Lewis river bridge near Woodland, to the Washington Engineering Company, Tacoma, Wash., $37,500; superstructure of the Skagit river bridge near Mt. Vernon, Wash., to Derrick & Derrick Company, Seattle, Wash., $34,673. William J. Roberts, State Highway Commissioner.

CONTEMPLATED WORK.

Santa Barbara, Cal.—The construction of a $60,000 bridge across Ventura river is contemplated by the Board of Supervisors of Ventura county.

Daytona, Fla.—D. D. & C. M. Rogers are preparing plans for the construction of a concrete bridge over the Halifax river.

Junction City, Kas.—The construction of a steel bridge across the Camden river, to cost about $50,000, is contemplated.

Stockton, Mo.—A $19,000 bond issue for road improvement has been voted.

Glendive, Mont.—A $170,000 bond issue for bridge construction has been voted and sold to the Minneapolis Trust Company.

Gloversville, N. Y.—A $20,444 bond issue for bridge construction has been voted. M. C. C. Stetson, city clerk.

Lawrence, N. Y.—A $10,000 bond issue for bridge construction has been voted. M. J. Pettis, village clerk.

Wilkesbarre, Pa.—Albert Lucius, consulting engineer, New York City, has prepared plans and estimates for a concrete bridge at West Market street.

Beeville, Tex.—A $15,000 bond issue for the construction of bridges has been voted. Dan Troy, county clerk.

Richmond, Va.—W. W. Latrobe has been instructed by the Chesterfield Board of Supervisors to request bids for the construction of bridges over Swift creek.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

CONTEMPLATED WORK.

Newark, N. J.—The Board of Public Works has ordered a preparation of plans and specifications for a 400-ton garbage disposal plant.

Munhall, Pa.—A $25,000 bond issue for the construction of a garbage disposal plant has been voted.

Parkersburg, W. Va.—The construction of a garbage incinerator for the purpose of destroying dry garbage is contemplated. Mayor Murdoch.

STREET LIGHTING.

CONTEMPLATED WORK.

Birmingham, Ala.—The Birmingham Railway, Light & Power Co. plans to place all electric wires under ground at a cost of about $260,000.

Alameda, Cal.—One hundred and fifty thousand dollars for the construction of a power house has been voted.

Lavonia, Ga.—A $5,000 bond issue for electric light construction has been voted. H. P. Sewell, city clerk.

Carroll, Ia.—The installation of an ornamental lighting system on a number of streets is contemplated.

Muscatine, Ia.—The extension of an ornamental lighting system on Mulberry street is contemplated.

Williamsburg, Ia.—The Troy Canning Company has been given a franchise to install and operate an electric light plant for a period of 25 years.

Lawrence, Kas.—The Commercial Club is endeavoring to secure an ornamental lighting system on Henry and Massachusetts streets.

Osawatomie, Kas.—A $20,000 bond issue for a municipal light plant and other improvements has been voted.

Topeka, Kan.—G. E. O'Neill, supt. of the city electric light plant, is preparing plans for the extension of an ornamental lighting system on 4th st.

Morris, Minn.—A $30,000 bond issue for electric light improvement has been voted. C. D. Burpee, village clerk.

Clarks, Neb.—A $5,000 bond issue for the construction of an electric lighting plant has been voted.

Lestershire, N. Y.—A $9,500 bond issue for the installation of an ornamental lighting system has been voted. W. C. Lewis, village clerk.

Lyons, N. Y.—A $10,000 bond issue for light improvement has been voted. W. J. Collins, vil. clk.

Schnectady, N. Y.—The installation of an ornamental lighting system on State street is contemplated. Henry W. Peck, general manager of the Schenectady Illuminating Company.

Cincinnati, O.—Resolutions have been passed for the lighting of the following streets with the inverted luminous arc system of electric lighting: Fourth avenue, three sections, Eighth avenue, Central avenue, Seventh avenue and Vine street. Arthur Espy, clerk of council.

Barnwell, S. C.—A $22,000 bond issue for the construction of an electric light and water works plant has been voted.

Anderson, S. C.—W. W. Hess, Philadelphia, Pa., has secured a franchise for the erection and operation of a gas plant.

South Bend, Wash.—The installation of an ornamental lighting system along the main business street is contemplated.

Duncan, B. C., Can.—The council is contemplating retaining an engineer for investigating the question of installing a municipal lighting and power plant.

FIRE APPARATUS.

BIDS REQUESTED.

Wichita, Kas.—June 3, 12 m. Constructing and installing a complete fire alarm and police telegraph system. Certified check $1,000. William Sence, city clerk.

Cleveland, O.—June 3, 12 m. Furnishing a police patrol for the city of Cleveland. Charles W. Stage, director of public safety; Hiram S. Stillman, secretary.

Portland, Ore.—June 27. Furnishing the following automobile fire apparatus: One automobile aerial, quick-raising truck, one auto pumping engine and eight auto combination chemical and hose wagons. Executive board of the fire department.

CONTEMPLATED WORK.

Prescott, Ark.—The installation of a fire alarm system is contemplated. T. D. Moody, chief.

Sacramento, Cal.—Chief Anderson has recommended the immediate changing of all engine trucks to automobile propelled trucks.

San Diego, Cal.—An $80,000 bond issue for fire department improvement has been voted.

Santa Clara, Cal.—A $5,500 bond issue for the purchase of fire apparatus has been voted. E. G. Senton, twn. clk.

Selma, Cal.—A $10,000 bond issue for the purchase of automobile fire apparatus has been voted.

Tampa, Fla.—The purchase of automobile fire trucks of the combination hose and chemical type is contemplated by the city.

Coeur D'Alene, Idaho.—The purchase of the following motor fire apparatus to cost about $15,000 is contemplated: One combination ladder, chemical and hose wagon and one combination pumping engine, hose wagon and chemical engine.

Muncie, Ind.—An appropriation has been made for the purchase of a chief's automobile.

Sioux City, Ia.—The Commercial Club will purchase automobile fire apparatus which will be leased to the city until the latter can purchase. It is proposed to purchase three fire engines, an automobile hook and ladder truck and some combination wagons.

Leavenworth, Kas.—The purchase of motor fire apparatus, hose and ladder equipment is contemplated.

Baltimore, Md.—The purchase of three automobile fire trucks is contemplated.

Boston, Mass.—The Revere fire engineers will purchase a combination automobile wagon and an automobile for the chief. Arthur Kimball, chief.

Grand Rapids, Mich.—The sum of $14,700 has been appropriated for the purchase of motor fire apparatus.

St. Joseph, Mo.—Fire Chief P. P. Kane has recommended the purchase of motor fire apparatus to cost about $75,000.

Orange, N. J.—A $15,000 bond issue for fire department improvement has been voted.

Auburn, N. Y.—The purchase of motor apparatus to cost about $22,000 is contemplated.

New York, N. Y.—Acting on advice of Controller Pendergast, Fire Chief Johnson rejected all bids for motor fire apparatus and will readvertise.

Akron, O.—Chief Murtz is contemplating the purchase of automobile apparatus for Fire Station No. 3.

East Liverpool, O.—R. J. Marshall, mayor, has recommended improvements to the fire department including motor apparatus.

Salem, O.—The purchase of motor fire apparatus and an automobile ambulance is contemplated by the city.

Meadville, Pa.—The purchase of a motor fire engine and a motor hose truck is contemplated.

Sharon, Pa.—A committee has been appointed to obtain prices on a combination automobile fire truck with pumping engine and an automobile hose wagon.

Chepachet, R. I.—A committee has been appointed to investigate motor fire apparatus. Howard W. Farmun, chr.

Bellingham, Wash.—The City Council has made an inspection trip to Vancouver, B. C., with a view to purchasing motor fire apparatus.